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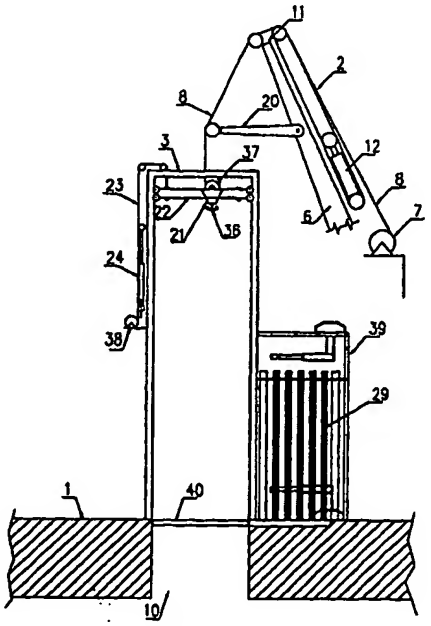
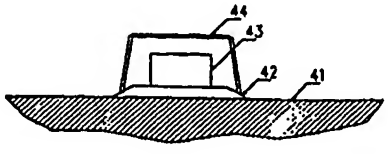
(54) Title: APPARATUS FOR A MOBILE INSTALLATION, ESPECIALLY AN OFFSHORE VESSEL

(57) Abstract

An apparatus for a mobile installation, especially an offshore vessel, comprising a crane (2) arranged on the deck of the vessel (1) and a derrick (3) provided on the vessel. The crane (2) comprises a crane pedestal (5) and a jib (6), and also a crane winch (7) and a crane wire (8). The derrick (3) comprises a derrick structure which is designed to be positioned over a moonpool (10) in the vessel (1). The crane wire (8) is arranged so as to be capable of operating a lifting means (21) inside the derrick (3), thus enabling the crane to be used as a hoisting device in the derrick (3).





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Apparatus for a mobile installation, especially an offshore vessel

The present invention relates to an apparatus for a mobile installation, especially an offshore vessel, in accordance with the preamble in claim 1 below.

A mobile installation, e.g., an offshore vessel, which is used for installation purposes, in particular for well intervention operations on the continental shelf, is as a rule equipped with a crane and a drilling derrick. The crane is used for lifting articles on board the ship. Such articles may be pipes, structures, anchors and other pieces of equipment which are to be installed, supplies that are required on board, etc. The derrick may be used for carrying out installation operations, maintenance of wells with the aid of a riser and in some cases also for drilling and production. To be capable of carrying out these operations, the derrick is equipped with a hoisting device, comprising a winch and a wire attached thereto. This winch must be relatively robust to be able to support the huge loads which are to be installed on or retrieved from the seabed, e.g., be connected to wells on the seabed. Furthermore, it must be heave compensated to be capable of performing controlled lowering and lifting. This winch is a contributory factor firstly to an increase in the costs of the vessel and secondly to an increase in the weight and thus a reduction in the useful load of the vessel

The object of the present invention is to cut the costs of the vessel and at the same time reduce the total weight of the vessel. This is achieved by eliminating the derrick winch, and instead using the winch of the already existing crane also as lifting device in the derrick, in accordance with the characterising clause of claim 1.

The present invention will now be explained in more detail with reference to the attached drawings, wherein:

Fig. 1 is a side view of a vessel comprising an apparatus according to the invention;
Fig. 2 is a top view of a vessel comprising an apparatus according to the invention;
Fig. 3 is a perspective view of a crane and a derrick according to the invention;
Fig. 4 is a perspective view of a crane and a derrick according to the invention, seen from the opposite side;
Fig. 5 is a perspective view of a crane and a drilling derrick according to an alternative embodiment of the invention;
Fig. 6 is a view of a crane and a derrick according to Fig. 5, seen from the opposite

side;

Figs. 7-39 show in several steps an example of a use of the apparatus according to the invention in the installation of a riser.

As mentioned above, Fig. 1 shows an offshore vessel 1, equipped with a crane 2 and a derrick 3, both of which are located on the deck 4 of the vessel. The crane 2 is of the pedestal-mounted type, comprising a rotating pedestal 5, a crane jib 6, a crane winch 7, a crane wire 8 and an active and/or passive heave compensator.

The derrick 3 is built as a latticed construction having four legs 9, and is, as shown in Fig. 2, positioned directly over a moonpool 10 in the vessel 1. The derrick may also be so designed that it can be moved from a position over the moonpool 10 to a position off this location, but it may also be permanently arranged over the moonpool 10.

As shown in Fig. 2, the crane 2 can be slewed 360° in both directions around the axis of the pedestal 5 and also make several revolutions about this axis. The derrick 3 is located within the reach of the crane 2, so that the outer end 11 of the crane jib 6 can be slewed to a position directly over the derrick 3.

Figs. 3 and 4 are perspective sectional views of a first embodiment of the apparatus according to the invention. Here, the crane 2 has slewed so that the outer end 11 of the crane jib 6, or a shown in this example, a racking arm 20, projects over the derrick 3. The crane wire 8 is passed from the winch 7 via an automatic heave compensator 12 over a sheave 18 at the outer end 11 of the crane jib 6, via a sheave 19 which is arranged at the outer end of the racking arm 20, and down along the centre axis of the derrick 3.

The automatic heave compensator 12 is arranged on the crane jib 6 and may be of a conventional type. Typically, this is a compensator comprising one or more hydraulic cylinders 26, which cylinders 26 act between a sheave 15 and two sheaves 14 and 16, placed side by side. The crane wire 8 is passed from the winch 7 over a sheave 13 at the outer end 11 of the crane jib 6, down along the jib 6, around the sheave 14 at the lower end of the heave compensator 12, around the sheave 15 at the upper end of the heave compensator 12, down once more along the crane jib 6 to the sheave 16 at the lower end of the heave compensator 12, up again along the crane jib 6 over a sheave 17 at the outer end 11 of the crane jib 6 and on to the sheave 18.

The cylinders 26 are preferably connected to an accumulator (not shown), for example air or nitrogen cylinders, in order to balance statically the load on the compensator. The crane winch 7 may be hydraulically operated or electrically operated. The heave compensator 12 may also include a winch, which is connected to a sensor, which senses the heave motions.

In the illustrated case, the crane wire 8 is directly connected to a lifting means 21, which is designed to grip equipment that is to be hoisted up and down inside the derrick 3.

Inside the derrick 3 there is arranged a stabilising frame (cursor frame) 22 which can be moved along guide lines 23. The stabilising frame 22 is guided along rails in the derrick 3 and is raised and lowered, e.g., with the aid of a separate winch (not shown). The derrick 3 is also equipped with conventional tensioner devices 24 to hold the guide lines 23 under sufficient tension, and also guide line winches 38, to pay out and take in the guide lines. Figures 3 and 4 also show tensioner devices 65 for tensioning lines connected to a riser.

The function of the stabilising frame 22 is to provide sideways stabilisation for the load hanging in the crane wire 8. This is particularly important when the load is to be passed through the moonpool 10, as the motions of the ship could easily cause the load to strike against the walls of the moonpool and might cause damage to both the load and the ship. When the load is hanging inside the derrick 3, it also essential to stabilise it sideways in order to prevent it from being flung against the derrick structure. The stabilising frame is therefore moved up and down with the load until the load leaves the vessel at the bottom of the moonpool 10. In the case of long loads, as shown and explained below, another stabilising frame is used in addition to the crane hook 36 and optionally a travelling block.

On the deck 4 of the vessel there are arranged rails 25 on which a trolley 46 can move between a position inside the derrick and a position outside the derrick. In Figures 3 and 4 the moonpool is closed by a moonpool door 40, in which there are made openings 66 for leading though pipes and guide lines.

The crane 2 may comprise a guiding device which automatically guides the crane jib into the right position over the derrick 3. This can be done in several ways, for example, with the aid of a laser at the outer end 11 of the crane jib 6, which registers a

reflection from a certain point on the derrick 3 or the deck 4, which point indicates the correct position of the outer end 11 of the crane jib 6 relative to the derrick 3.

Fig, 4 shows that the derrick 3 is also equipped with a pipe rack 39 having a pipe handling device 27, which may be of a conventional type, comprising a gripper arm 28 for gripping the upper end of the pipes 29, and optionally a corresponding gripper arm for gripping the lower end of the pipes 29. The gripper arm 28 is designed to move the pipes 29 into the derrick 3. As shown in Figures 3 and 4, the derrick 3 comprises two openings 67 and 68, through which equipment can be brought into the derrick either via the opening 67 with the aid of the tool trolley 46 or via the opening 58 from the pipe rack 39. Instead of the tool trolley 46, suitable lifting gear, for instance, may be used to bring equipment into the derrick 3.

Figs. 5 and 6 show an alternative embodiment of the invention, which, for example, might be suitable solution if the crane 2 is positioned at such great distance from the derrick 3 that the outer end 11 of the crane jib 6 will not reach a position over the derrick 3. In this case, the crane wire 8 is passed in the same way as in the exemplary embodiment according to Figs. 3 and 4 until the crane wire 8 leaves the outer end 11 of the crane jib 6. From here, the crane wire extends down to a first sheave 30, for example, positioned as shown at the foot of the derrick 3, via a second sheave 31 to a third sheave 32 at the top of the derrick 3, over a fourth sheave centrally located in the top of the derrick 3, and down inside the derrick 3. If the crane and the derrick are located very far apart, the crane wire can also be passed under the deck to the derrick.

Fig. 6 shows a winch 35 connected to a wire 69. This winch 35 is used to transport relatively light loads down along the crane wire 8 or its load when there is a need to move equipment up or down along the crane wire 8.

Figs. 7-39 show an example of the use of the apparatus according to the invention in a well intervention operation, in this case for the installation of a wellhead Christmas tree and a riser. This example shows only one of the many applications of the apparatus according to the invention and is intended to illustrate that although according to the invention the crane is used as a hoisting device inside the derrick, the applicability of the apparatus is at least as good as in a conventional derrick/winch combination.

The same reference numerals are used in all Figs. 7-39 as were used in Figs. 1-6. Thus, Fig. 7 is a schematic illustration of the crane 2 and the derrick 3. In this case, the crane

wire 8 is passed from the winch 7 down into the derrick 3 via the heave compensator 12, the outer end 11 of the crane jib 6 and the racking arm 20. Here, the crane wire 8 is passed up to a fixed attachment point 37 in the derrick 3 via a travelling block 21, which in this case is equipped with a crane hook 36. A stabilising frame 22 is shown in the derrick. A number of guide wires 23, preferably four, are connected via a heave compensator 24 to a guide wire winch 38. As explained below, the guide wires 23 are to be connected to a subsea template 42, to guide the load during submersion and elevation. A pipe rack 39 containing a plurality of pipes 29 is shown connection with the derrick 3. The vessel's 1 moonpool 10 is equipped with a moonpool door 40, which can open and close the moonpool 10 by being shifted sideways. Furthermore, on the seabed 41 there is shown a subsea template 42, upon which a wellhead Christmas tree cap 43 and a hatch 44 are placed.

Fig. 7 illustrates a situation where the vessel 1 is immediately above the subsea template 42 and the installation process is just about to start. First, a tool 45 to remove the wellhead Christmas tree cap 43 is brought inside the derrick 3 on a tool trolley 46, which can be moved on rails 25 (see Fig. 3). At this point the moonpool door 40 is closed.

As shown in Figure 8, the hatch 44 is opened, and with the aid of the heave compensator 24 the guide lines 23 are passed down to the subsea template 42 and are attached thereto. In Figs. 7-39 only one guide line 23 is shown in order to simplify the drawings, but it should be understood that in reality there are preferably four guide lines located close to each of the legs 9 of the derrick 3.

As shown in Fig. 9, travelling block 21 and hook 36 are lowered together with the stabilising frame 22 down to a position immediately above the moonpool door 40, so that the frame surrounds the tool 45 in order to stabilise it sideways. The crane hook 36 then grips the tool 45, and an umbilical (not shown) and a pod line (not shown) are connected to the tool 45.

As shown in Fig. 10, the tool 45 and the stabilising frame 22 are now lifted up some way inside the derrick so that the tool 45 is clear of the tool trolley 46. The tool trolley 46 is then moved out of the derrick 3.

As shown in Fig. 11, the moonpool door 40 is now opened and the tool 45 and the stabilising frame 22 are lowered down to the bottom of the moonpool 10.

As shown in Fig. 12, the tool 45 is now lowered down to the subsea template 42 where it is connected to the Christmas tree cap 43. During this submersion, the tool 45 is guided in the guide lines 23. The stabilising frame 22 remains at the bottom of the moonpool 10, as it does not have any function outside the vessel.

As shown in Fig. 13, both the tool 45 and the Christmas tree cap 43 connected thereto are lifted to the surface, these first being lifted up to the stabilising frame 22, which, as mentioned above, stabilises the load sideways when it is passed through the moonpool 10 and into the derrick 3.

As Fig. 14 shows, the moonpool door 40 is then closed and the tool trolley is once more moved into the derrick 3, as shown in Fig. 15, to receive the Christmas tree cap 43 and the tool 45 when they are lowered onto the tool trolley 46 and the crane hook 36 is released from this load.

As Fig. 16 shows, the tool trolley 46 carrying the Christmas tree cap 43 and the tool 45 is then moved out of the derrick 3. A second stabilising frame 47, which, for example, may have a resting position in the uppermost end of the derrick 3 or can be installed in the derrick in those cases there is a need therefor, is also shown in Fig. 16. This stabilising frame 47 is used for sideways stabilisation when lifting and lowering long articles, where there is a need for two stabilising frames in order to obtain sufficient sideways stabilisation or stabilisation of the crane hook 36 and/or the travelling block 21. An elevator 48 is now suspended in the crane hook.

As shown in Fig. 17, the pipe rack 39 comprises a upper gripper arm 49 and a lower gripper arm 50. These gripper arms 49 and 50 now grip a stress joint (drill collar) 51 and pass it into the derrick. At the same time the guide lines 23 are slackened and the vessel 1 is now moved off location over the subsea template 42. This is done in order to obtain sufficient free depth below the vessel 1 during the further stages of the installation process, without there being any risk of damaging the subsea template 42 or equipment which may strike against this.

As is shown in Fig. 18, the elevator 48 now grips the upper end of the stress joint 51. To stabilise the lower end of the stress joint 51, a manipulator arm 52 is used, which is connected to the derrick 3 by one of its ends. The tool trolley 46 is then once again moved into the derrick 3, now carrying a riser package 53 and a Christmas tree tool 54.

As shown in Fig. 19, the stabilising frame 22 is now lowered down to the Christmas tree tool 54 and the stress joint 51 is connected to the Christmas tree tool 54, whilst the stabilising frame 47 stabilises the upper end of the stress joint 51.

As shown in Fig. 20, the whole unit consisting of the stress joint 51, the Christmas tree tool 54 and the lower riser package 53 is lifted. During this lift the stabilising frame 22 stabilises the unit at its lower end, whilst the stabilising frame 47 stabilises the upper end at the elevator 48. The tool trolley 46 is moved out of the derrick 3.

As shown in Fig. 21, the moonpool door 40 is now opened, and as shown in Fig. 22, the unit consisting of the stress joint 51, the Christmas tree tool 54 and the lower riser package 53 is lowered until the upper end of the stress joint 51 is just above deck level. Now the moonpool door 40 is closed and a torque spider tool 56 is placed on the upper end of the stress joint 51 in order to keep this fixed over the moonpool door. The elevator 48 then releases the stress joint 51.

As shown in fig. 23, a riser joint 57 is taken from the pipe rack 39 and passed with the aid of the gripper arms 49 and 50 into the derrick 3 where its upper end is gripped by the elevator 48.

As shown in Fig. 24, the lower end of the riser joint 57 is now brought together with the upper end of the stress joint 51 and connected thereto with the aid of the torque spider tool 56.

As shown in Fig. 25, the torque spider tool 56 releases the stress joint 51 and this is now lowered further down suspended in the riser joint 57. The torque spider tool 56 is then secured to the upper end of the riser joint 57, and the elevator is released again and lifted upwards in the derrick 3. A new riser joint 58 is now taken from the pipe rack and is connected to the riser joint 57 in the same way as shown in Figs. 23, 24 and 25. The stages shown in Figs. 23, 24 and 25 are repeated until the riser has reached a sufficient length.

As shown in Fig. 26, a riser tension joint 59 is now suspended in the elevator 48 and is fastened to the riser 60, as shown in Fig. 27.

Fig. 28 shows that the riser tension wires 61 are attached to the riser tension joint 59.

The torque spider tool 56 is then released as shown in Fig. 29. The moonpool door 40 is then opened. As shown in Fig. 30, the riser is now lowered so far that the upper end of the riser tension joint 59 is immediately above deck level. The moonpool door 40 is then closed and the torque spider tool 56 is reattached to the riser tension joint 59. As shown in Fig. 31, the elevator 48 is now lifted upwards in the derrick 3. A tool, here in the form of a coil tubing injector 62, is then moved into the derrick 3 on the tool trolley 46.

As shown in Fig. 32, the coil tubing injector 62 is now lifted into a vertical position in the derrick 3 and the stabilising frame is lowered to stabilise it sideways at its lower end.

Whilst the coil tubing injector 62 is stabilised by the stabilising frame 22, it is lifted up in the derrick 3 by means of the elevator 48, as shown in Fig. 33. A surface Christmas tree 63 is then brought into the derrick as shown in Fig. 34.

As shown in Fig. 35, the coil tubing injector 62 is then lowered down onto the surface Christmas tree 63. The unit consisting of the injector head 62 and the surface tree 63 is then lifted upwards in the derrick 3 as shown in Fig. 36 and an adapter joint 64 is moved into the derrick 3. This is connected at its ends to the riser tension joint 59 and the surface tree 63, respectively.

As shown in Fig. 37, the whole riser with all its units from the injector head 62 to the lower riser package 53 is now lifted upwards in the derrick until the lower riser package 53 is clear of the subsea template 42.

As shown in Fig. 38, the vessel is now moved into position over the subsea template 42 and active heave compensation with the aid of both the crane 2 and the guide lines' 23 heave compensator is started. The lower riser package 53 is thus held still relative to the subsea template 42.

Finally, as shown in Fig. 39, the whole riser, including all units from injector head 62 to the lower riser package 53, is lowered down towards the subsea template 42 until the lower riser package 53 can be connected to the subsea template 42. The installation has now been completed, and the switch to passive heave compensation can be made and maintenance and other intervention operations can be carried out in the well.

The installation which has been illustrated and explained in connection with Figs. 7 - 39 shows that by using the crane as a hoisting means in the derrick it is possible to carry out the same complicated installations as efficiently and simply as could be done previously with the aid of a winch, wire, heave compensator and power supply installed in the derrick.

Patent claims

1.

An apparatus for a mobile installation, especially an offshore vessel, comprising a crane (2) arranged on the deck of the vessel (1) and a derrick (3) provided on the vessel, which crane (2) comprises a crane pedestal (5) and a jib (6), and also a crane winch (7) and a crane wire (8), and which derrick (3) comprises a derrick structure which is designed to be positioned over a moonpool (10) in the vessel (1), the crane wire (8) being arranged so as to be capable of operating a lifting means (21) inside the derrick (3), thus enabling the crane to be used as a hoisting device in the derrick (3), characterised in that the crane (2) comprises a heave compensator (12), which heave compensator (12) is arranged so as to be capable of being used also when the crane winch (7) functions as a hoisting device in the derrick (3), in order to heave compensate loads which are supported through/from the derrick, and that the crane jib is equipped with a racking arm (20), at the outer end of which there is provided a guide sheave (19) or the like for guiding the crane wire (8) down towards a predetermined point in the derrick (3).

2.

An apparatus according to claim 1, characterised in that the crane comprises a crane hook (36), which is arranged to move vertically inside the derrick (3), and optionally is attached to a travelling block.

3.

An apparatus according to any one of the preceding claims, characterised in that the crane wire (8) is designed to be connected to a yoke provided in the derrick (3), which yoke is moved in guide rails, guide wires or the like inside the derrick.

4.

An apparatus according to claim 3, characterised in that the yoke is a stabilising frame (22, 47) which is designed to provide sideways stabilisation for loads and/or lifting means (21).

5.

An apparatus according to claim 4, characterised in that the derrick (3) comprises two stabilising frames (22, 47), one of which is designed to stabilise the load at its lower end

and the other is designed to stabilise the load at its upper end and/or the lifting means (21).

6.

An apparatus according to any one of the preceding claims, characterised in that the end of the crane wire (8) is arranged so as to be capable of being connected to the derrick structure and extend via a travelling block to the crane jib (6).

7.

An apparatus according to claims 1, 3, 4, or 5, characterised in that the crane wire (8) is arranged to be passed via idler sheaves (30, 31, 32) to the upper end of the derrick (3).

8.

An apparatus according to any one of the preceding claims, characterised in that the derrick (3) is equipped with guide lines (23), attached to a guide line winch (38) and a heave compensator (24), in order to guide loads down to and up from the seabed.

Fig. 1

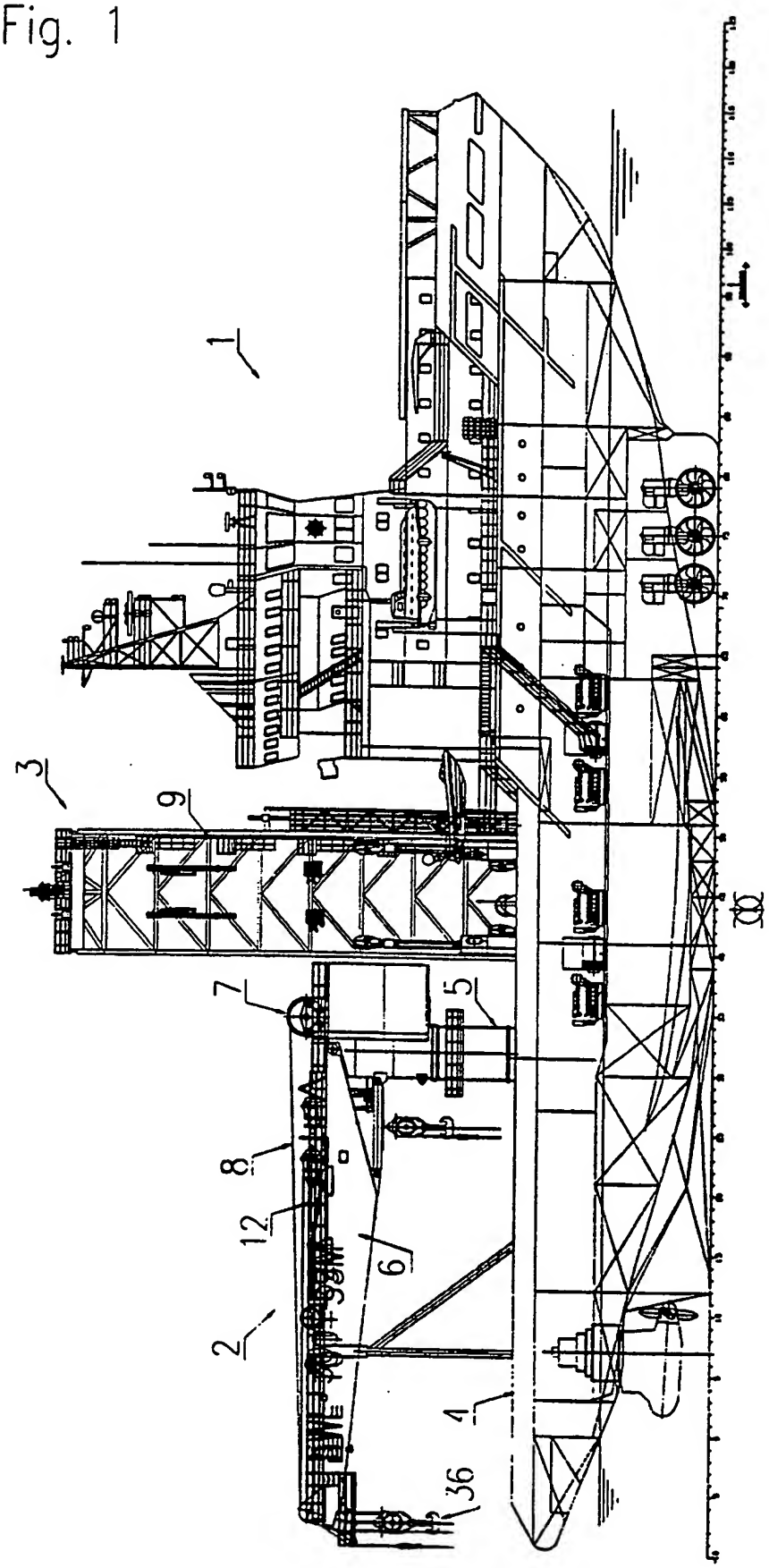

Fig. 2

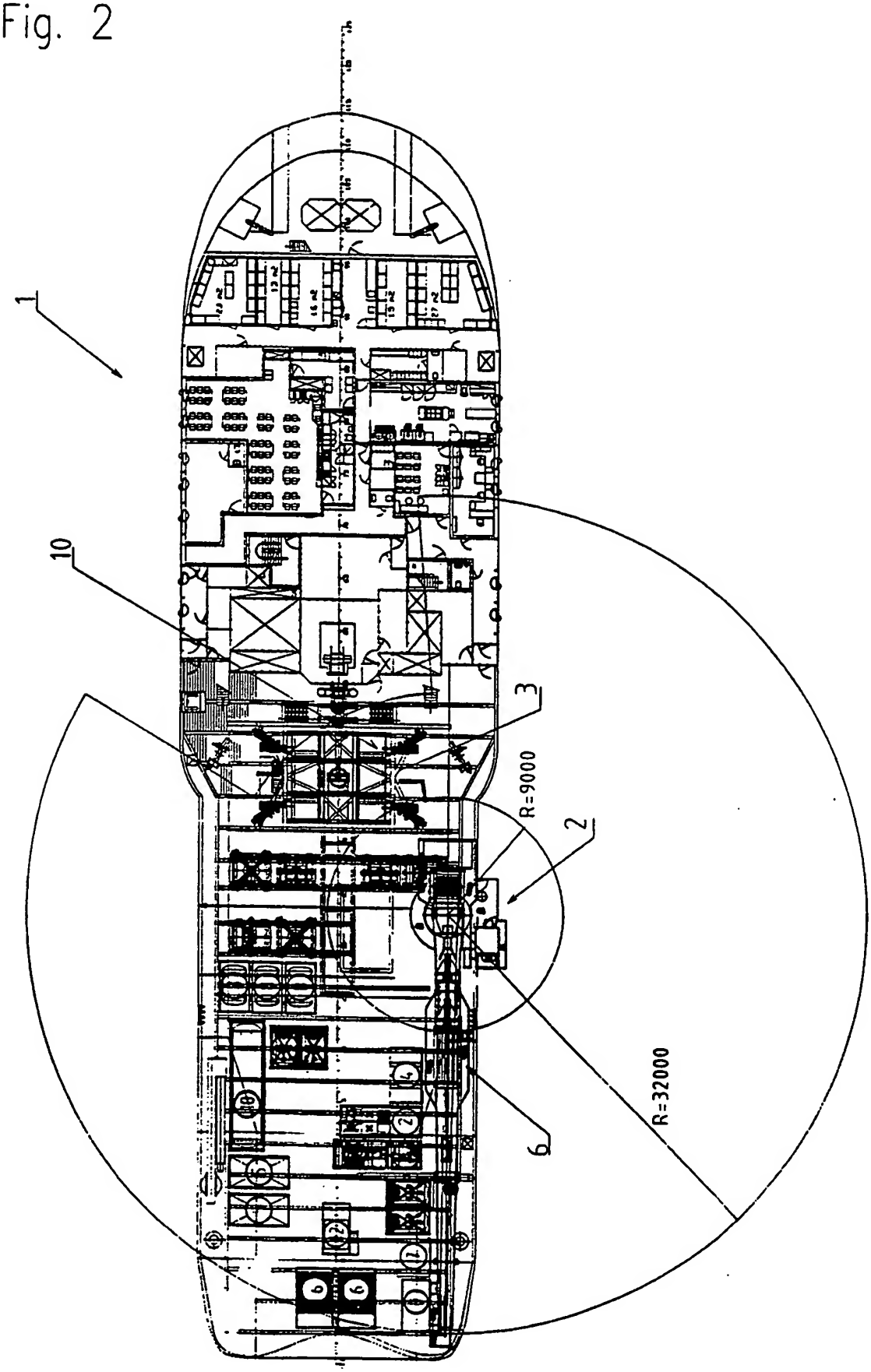

FIG. 3

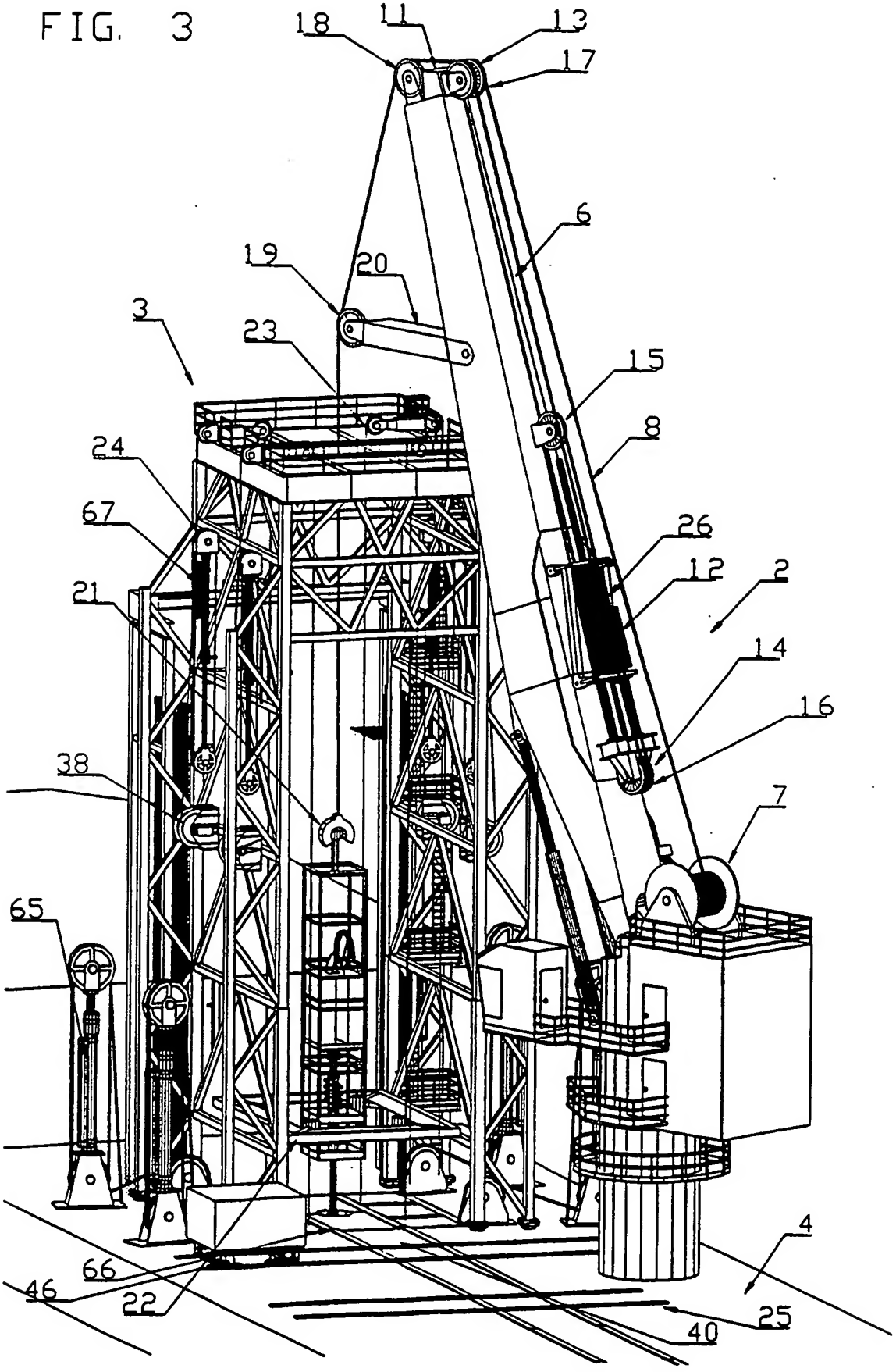
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FIG. 4

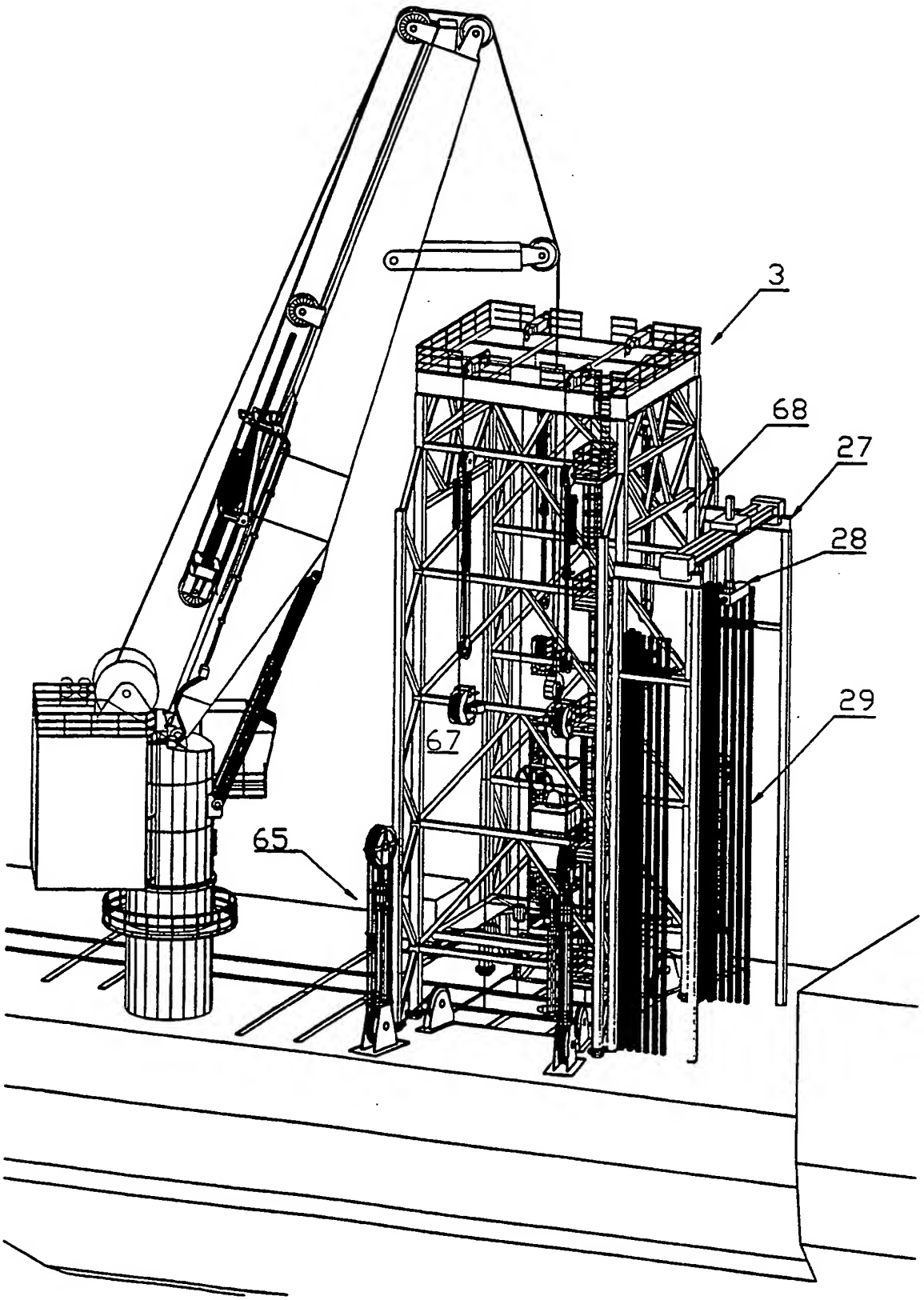


FIG. 5

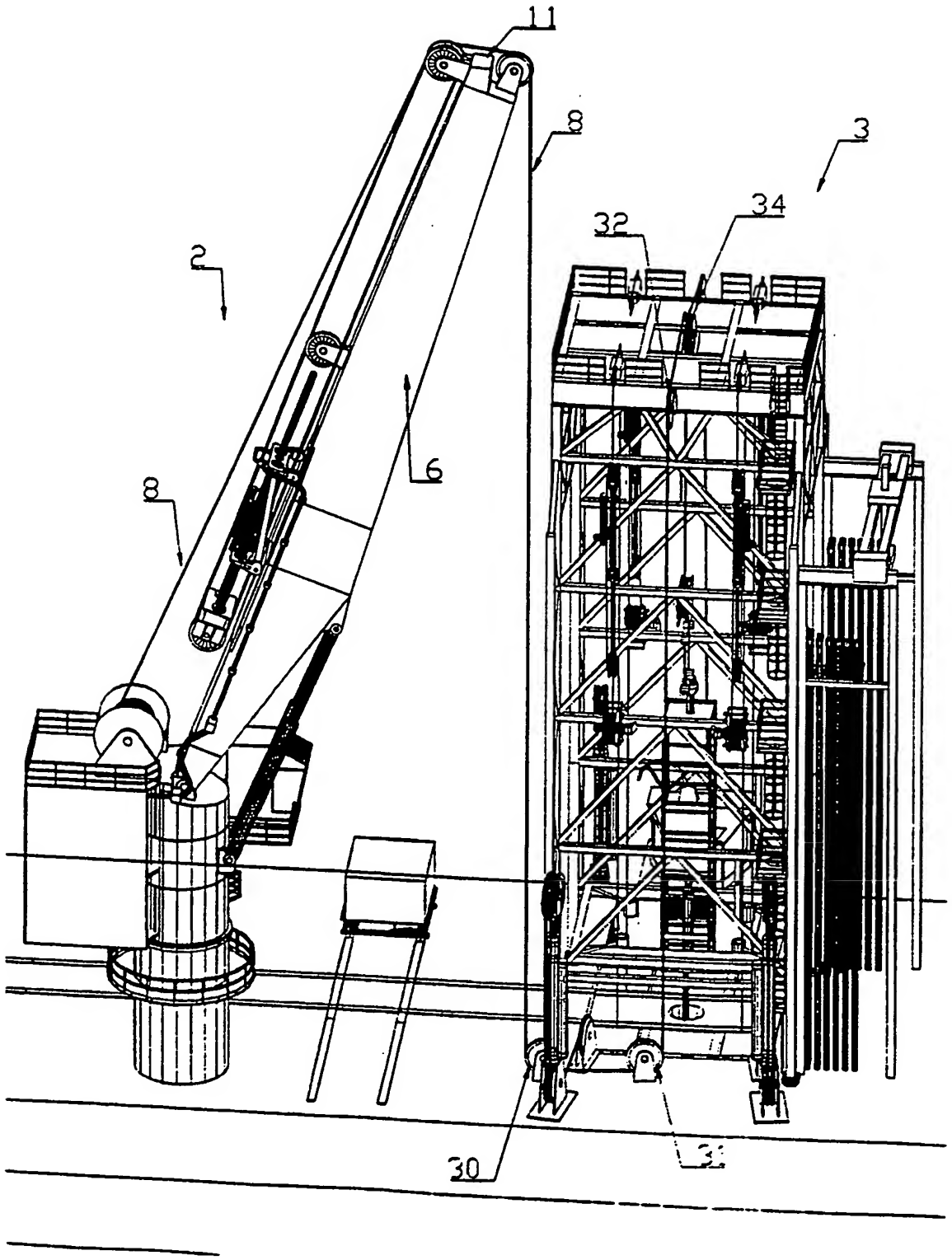


FIG. 6

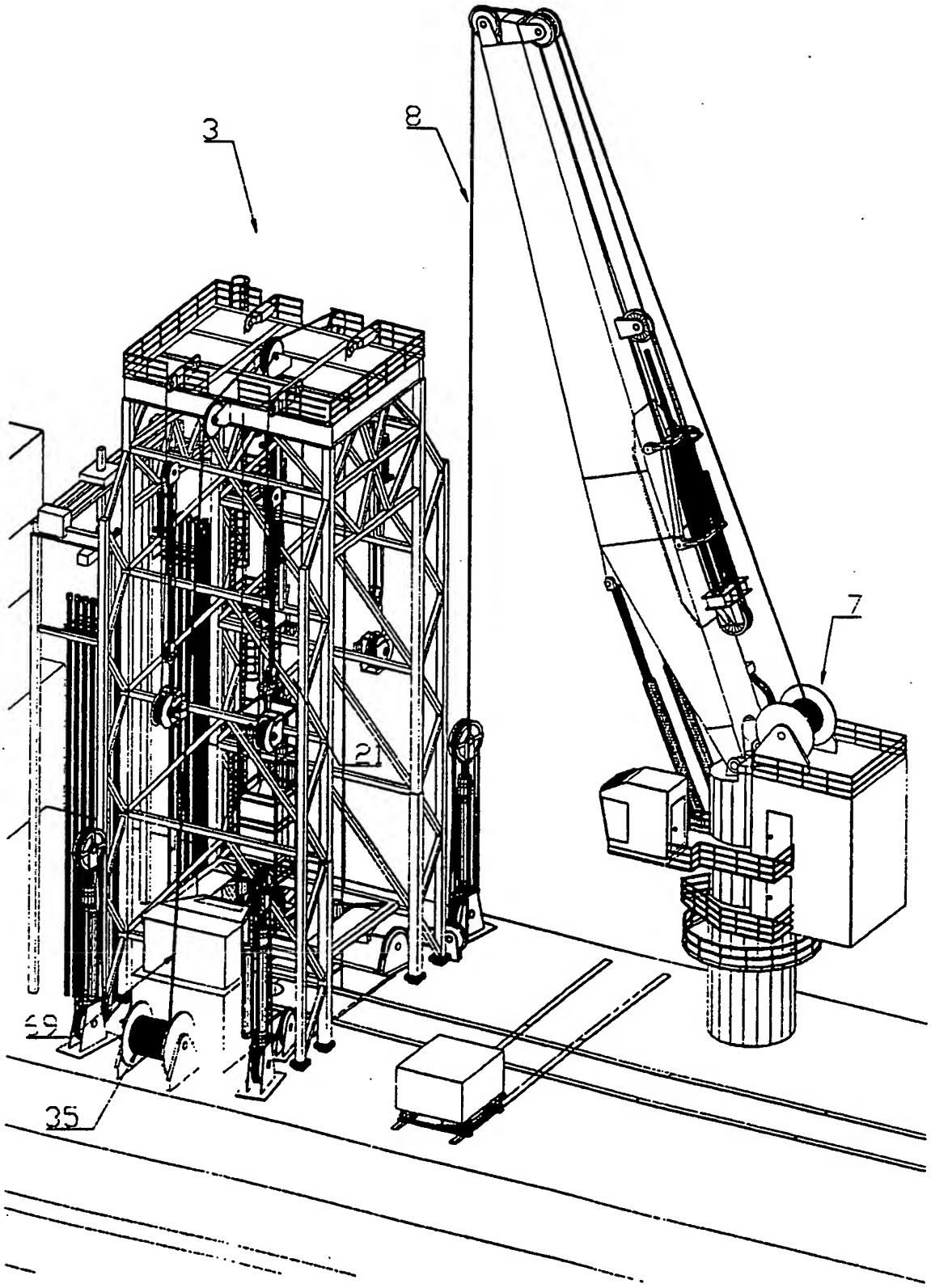
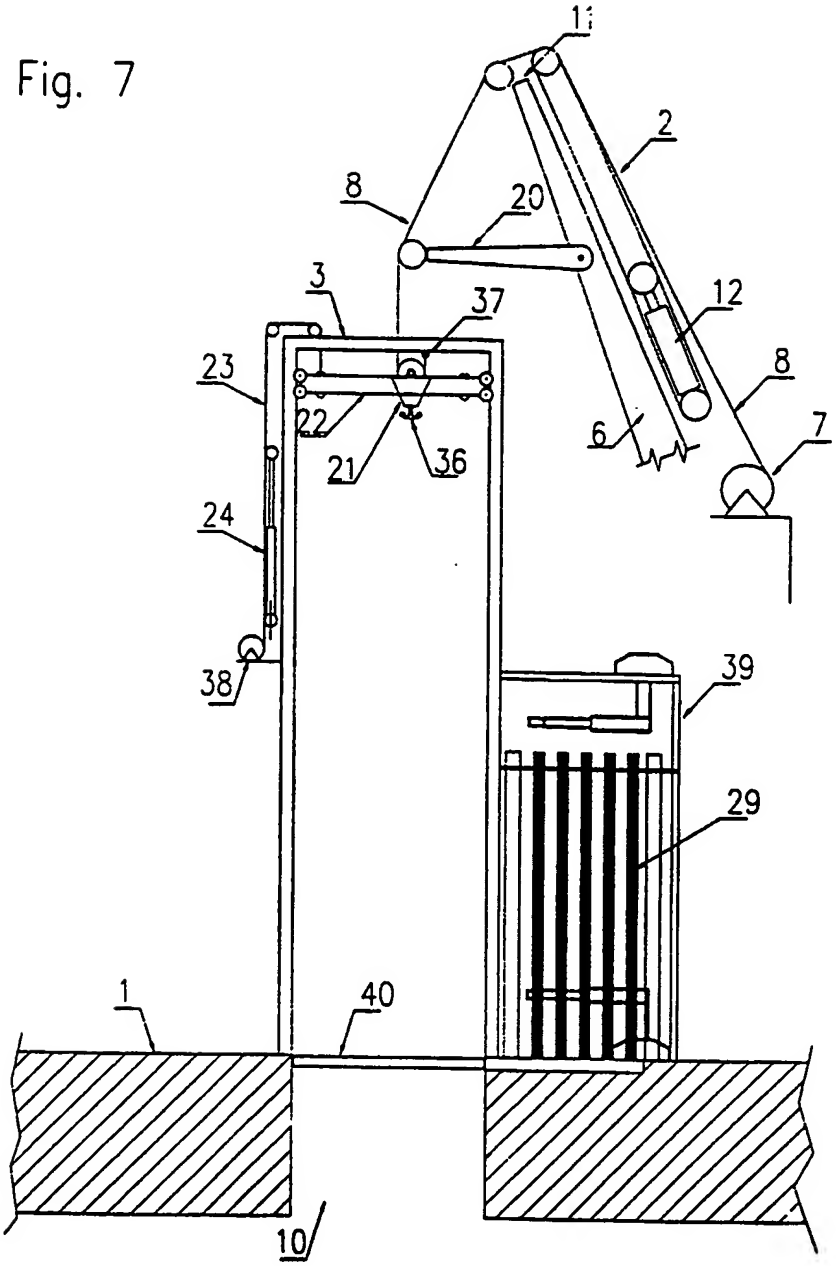
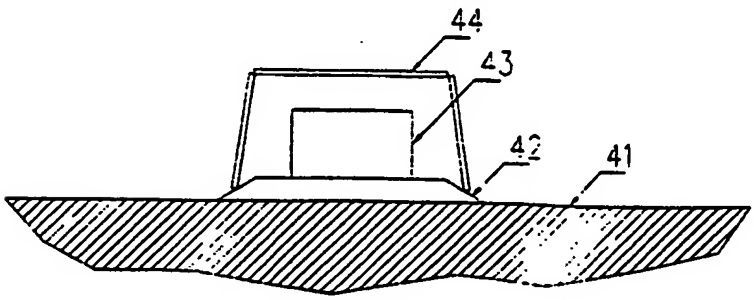


Fig. 7





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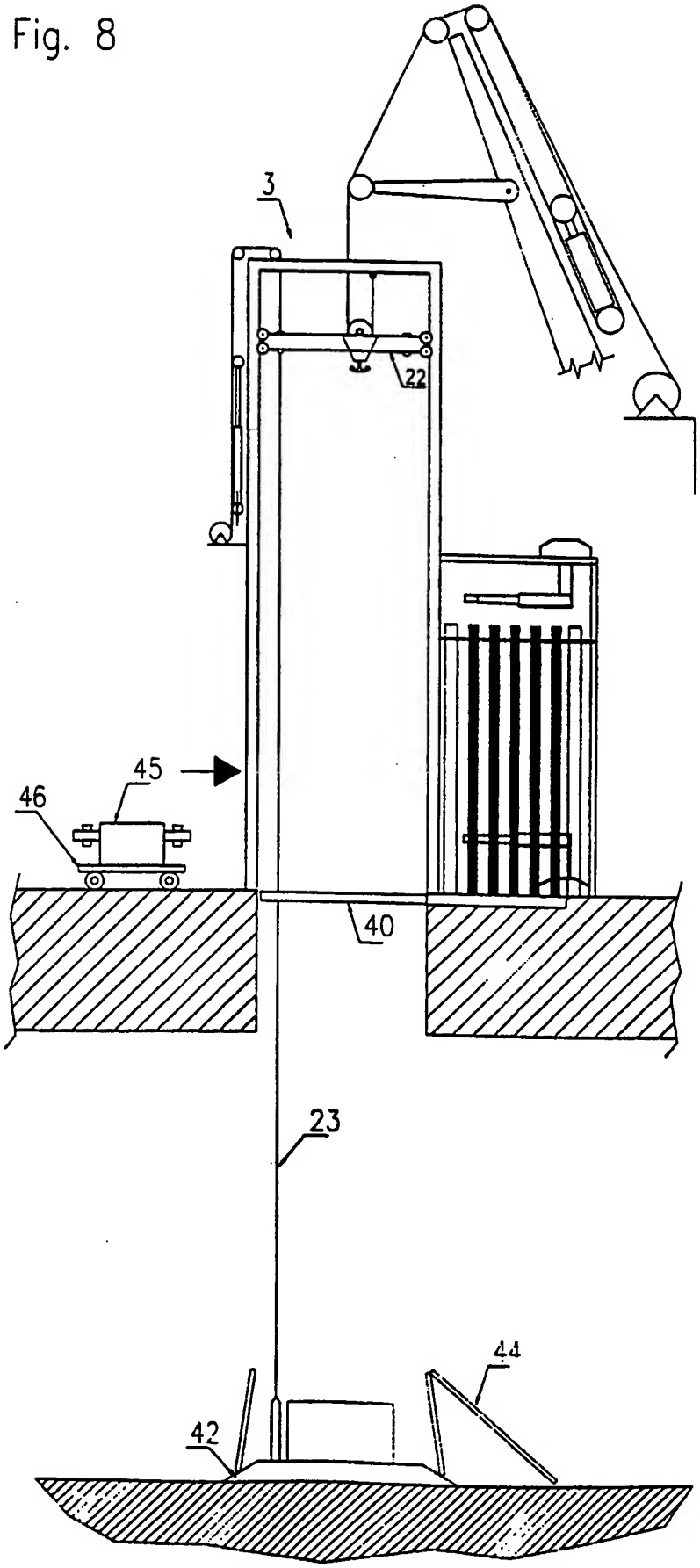

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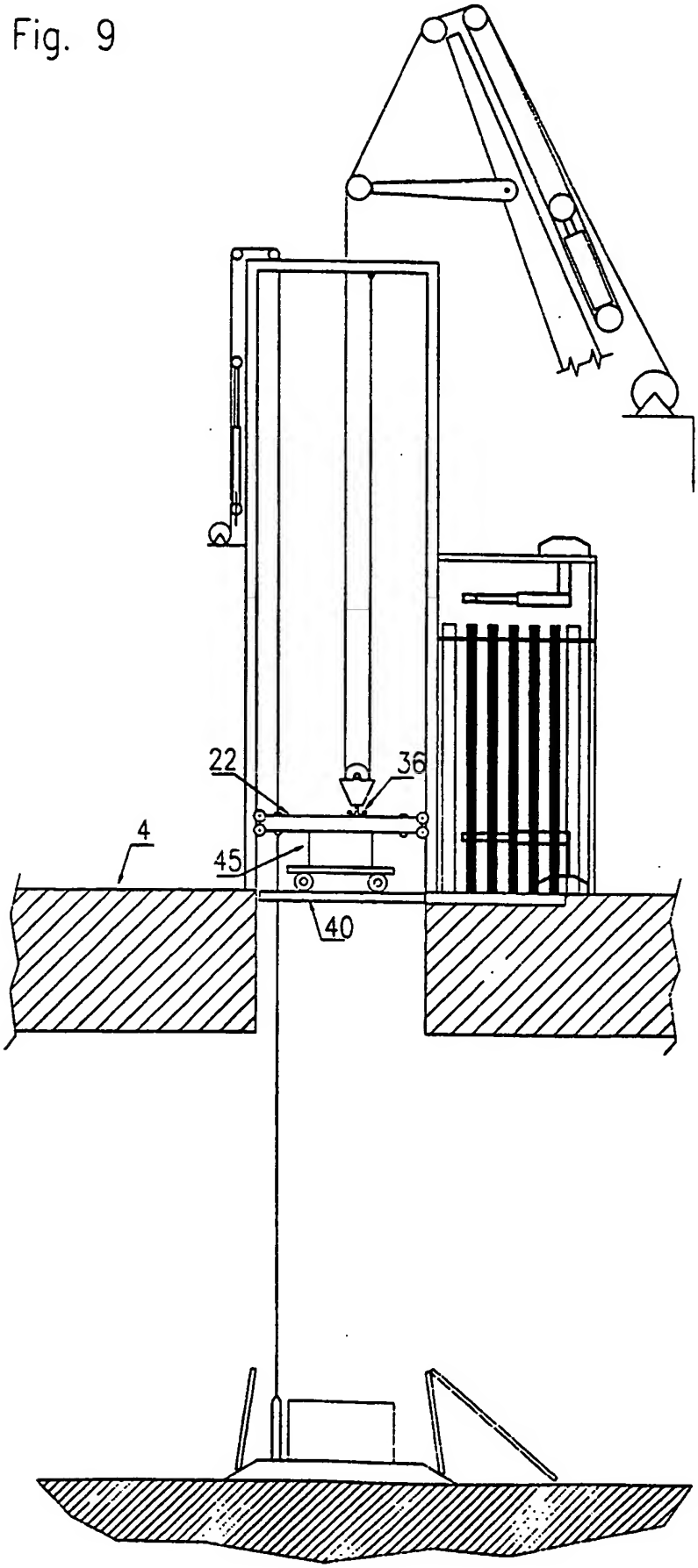

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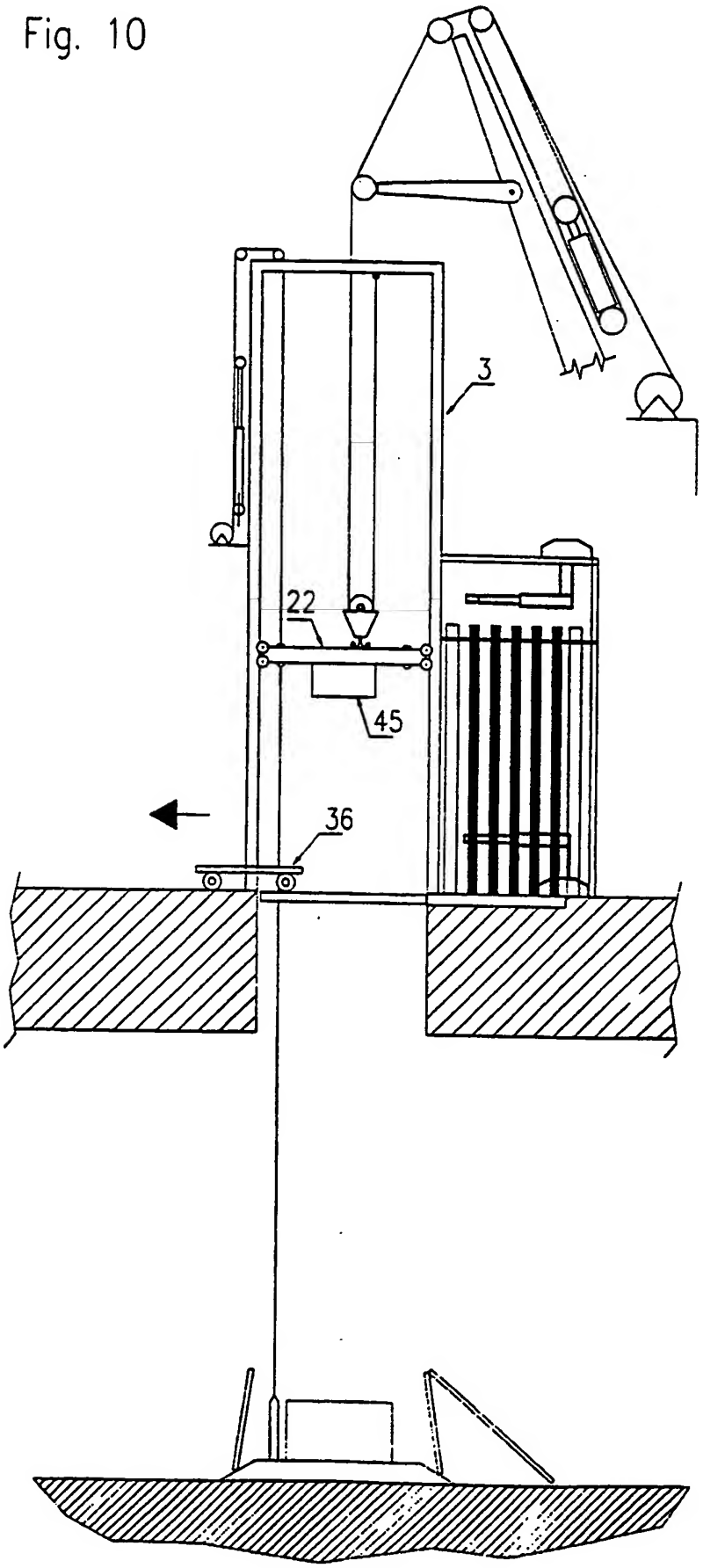

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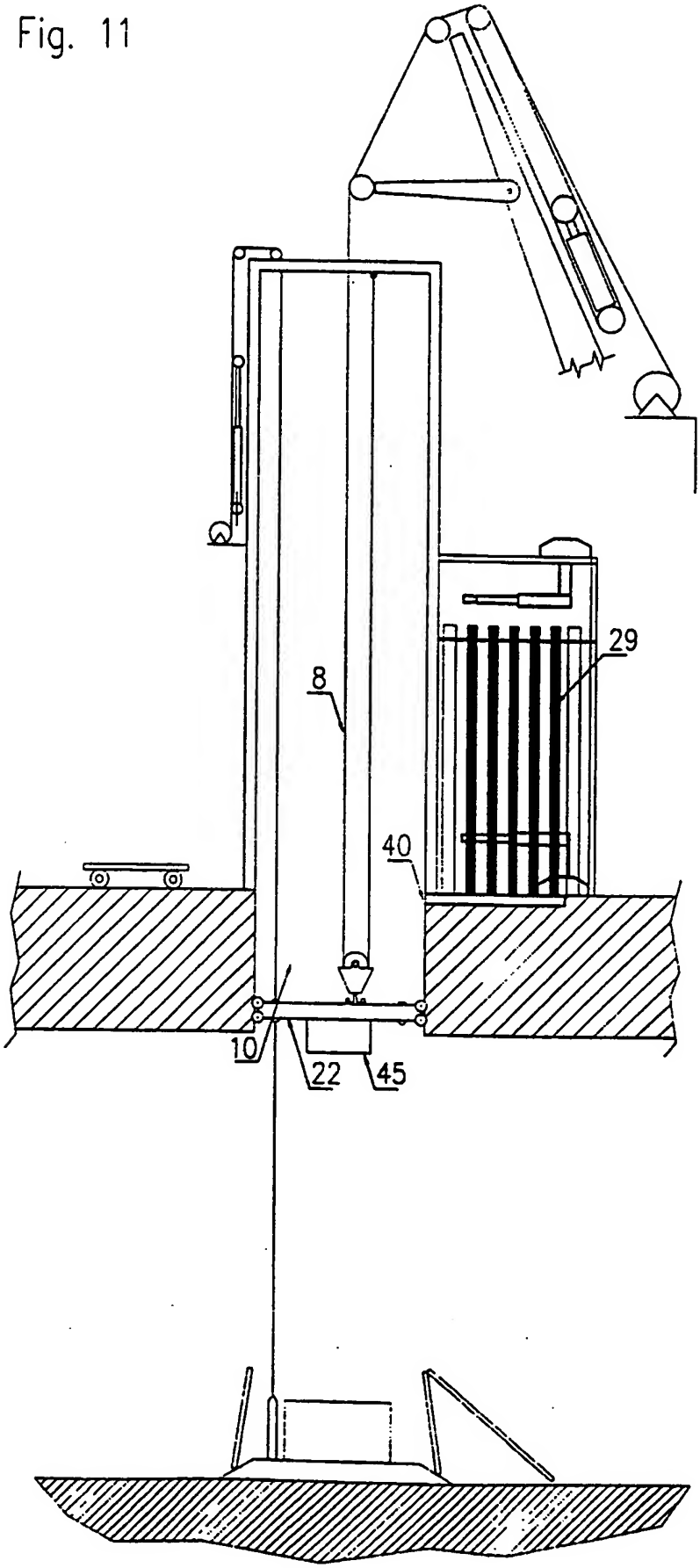

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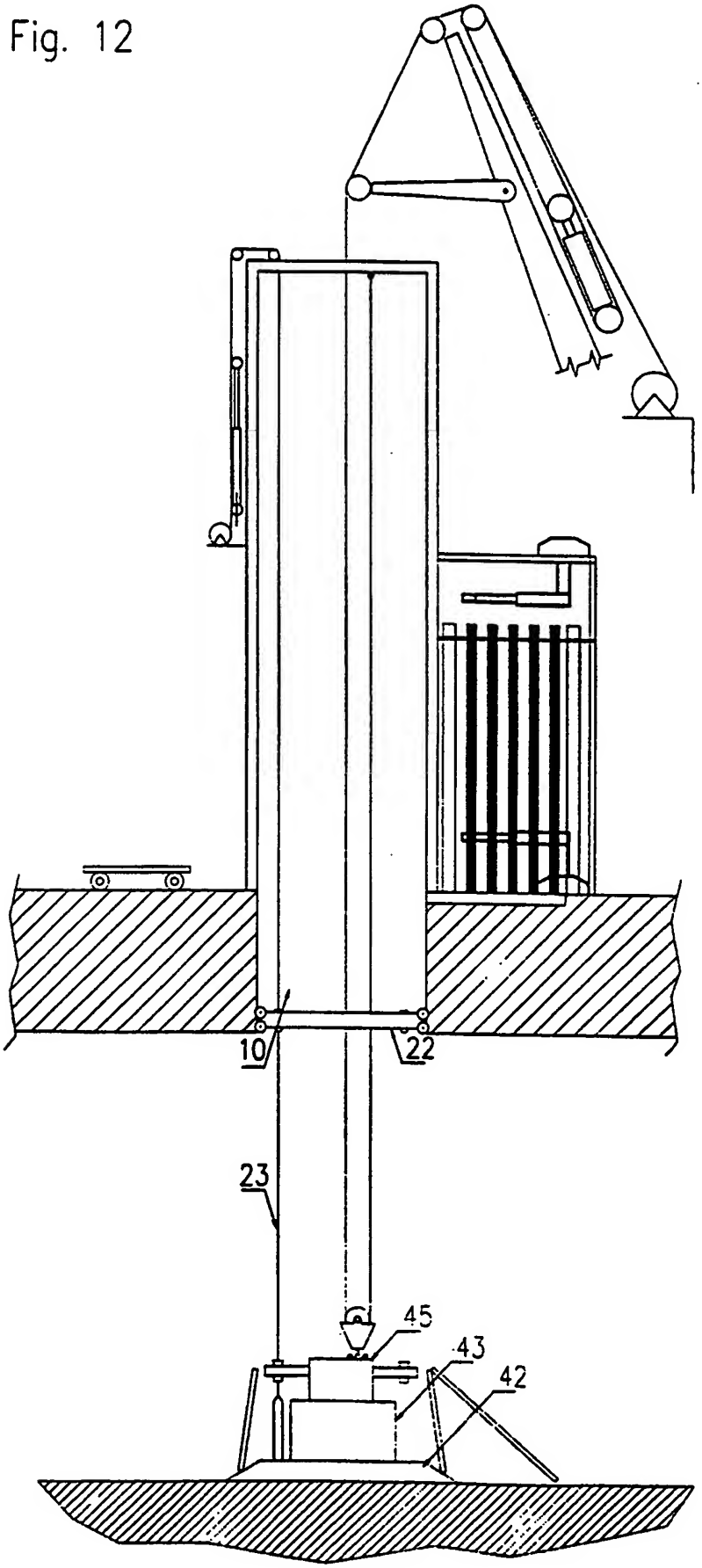

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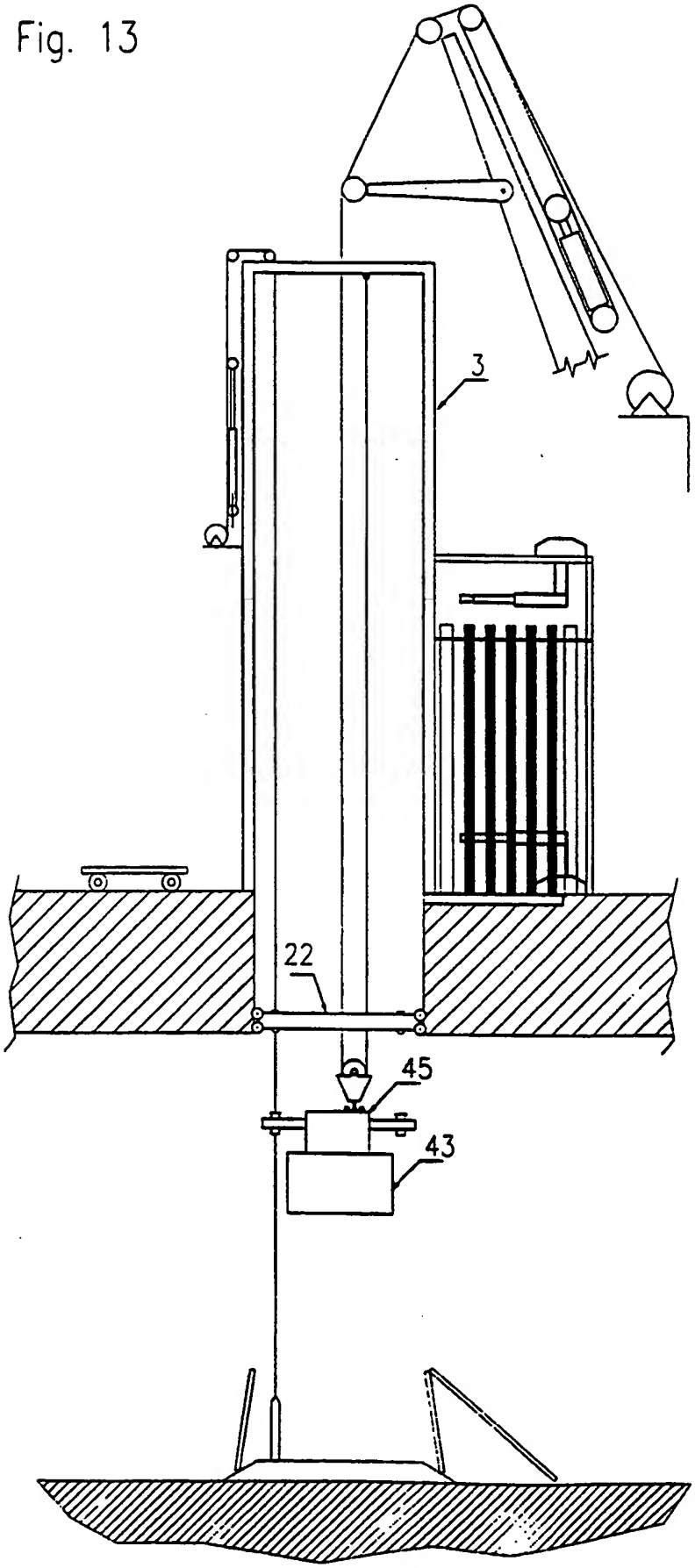

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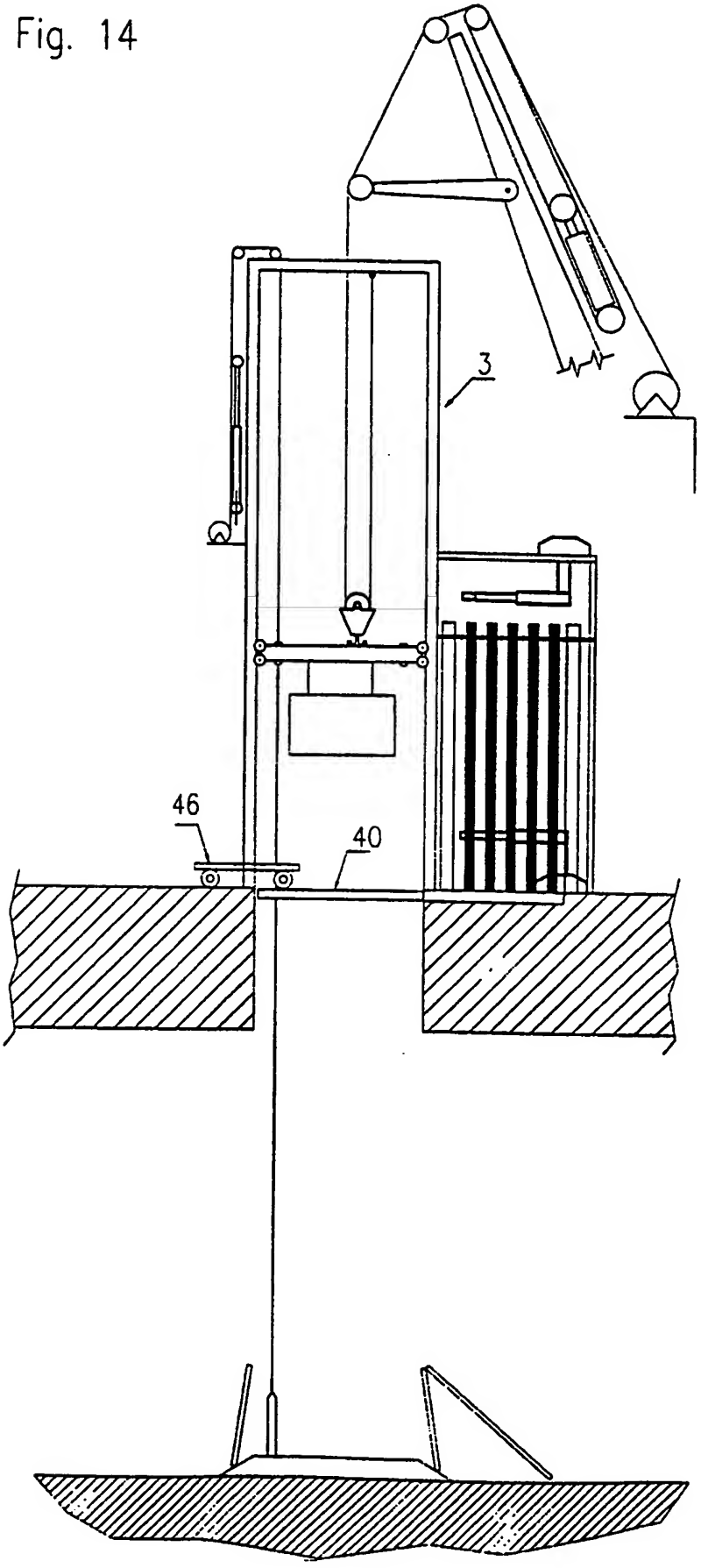

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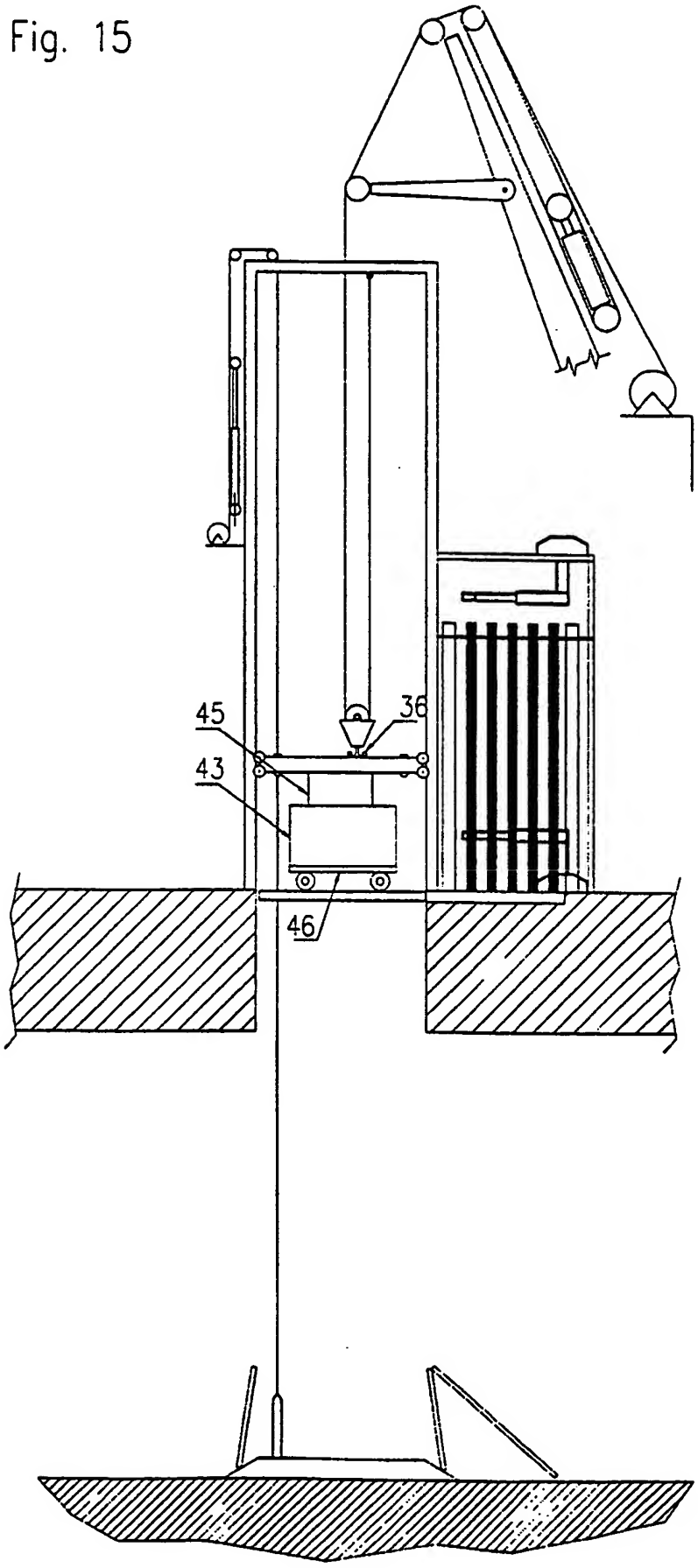

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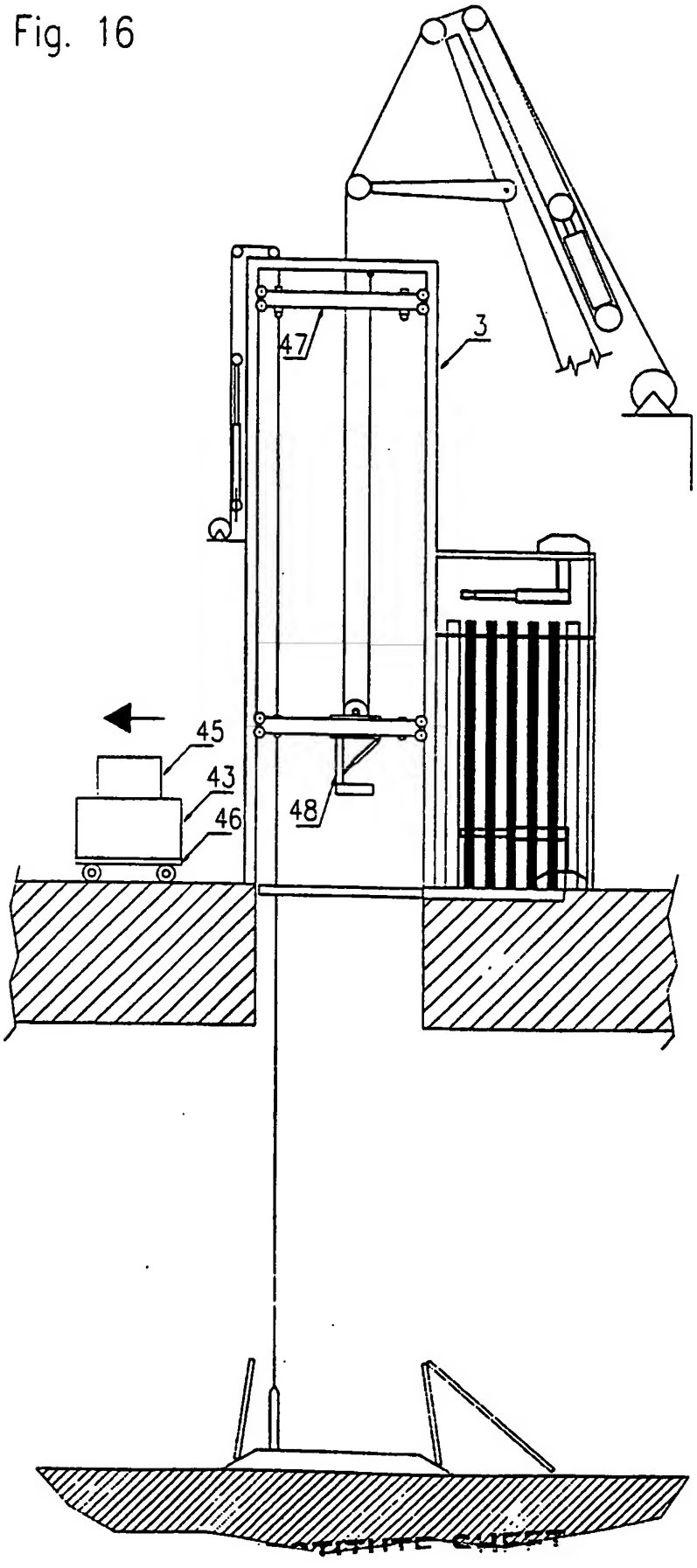

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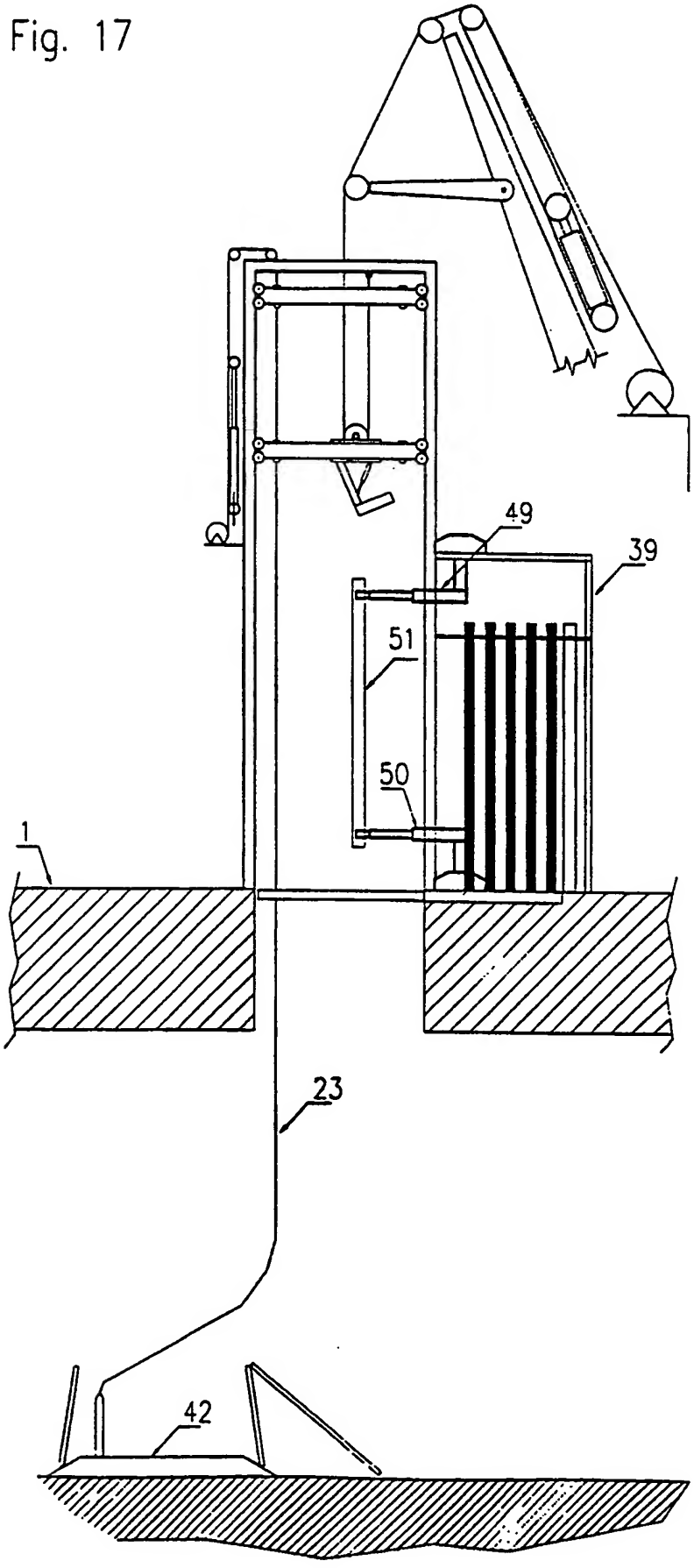

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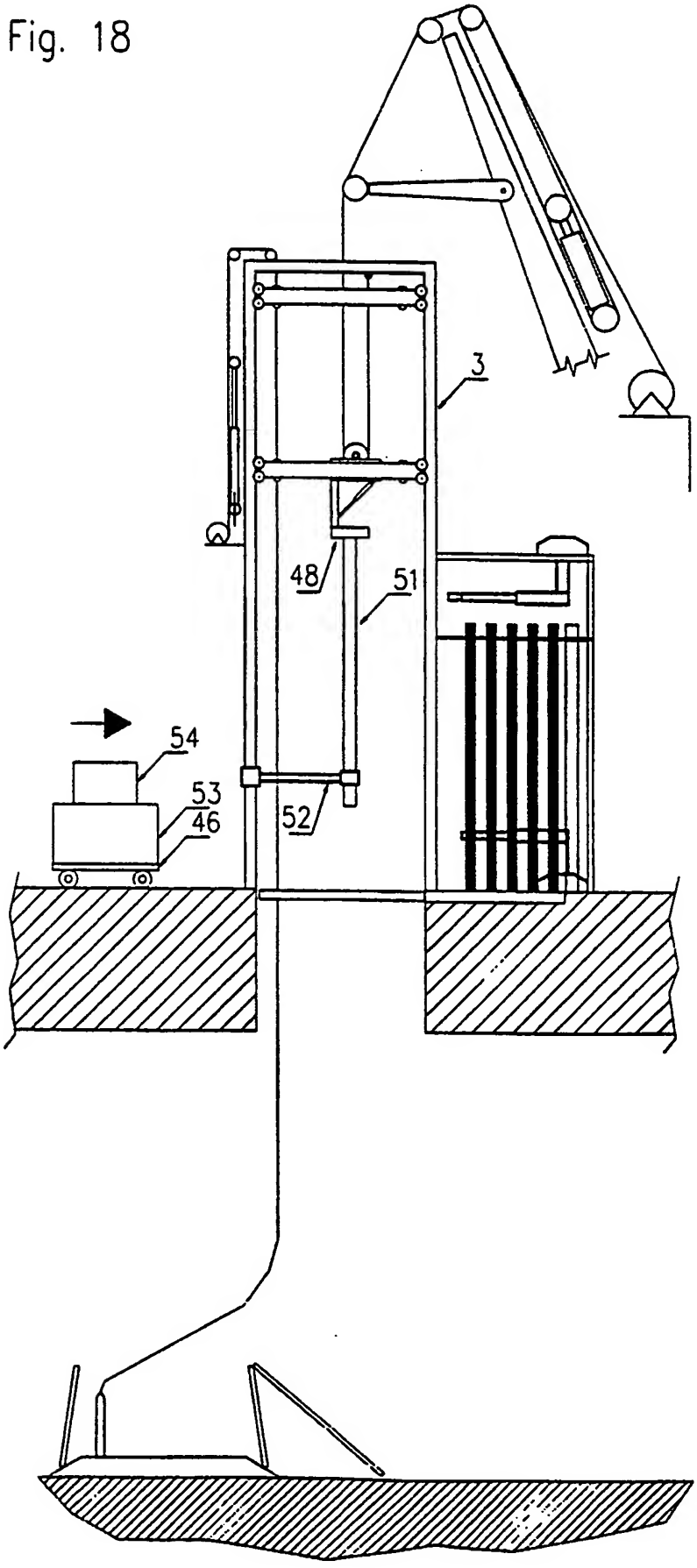

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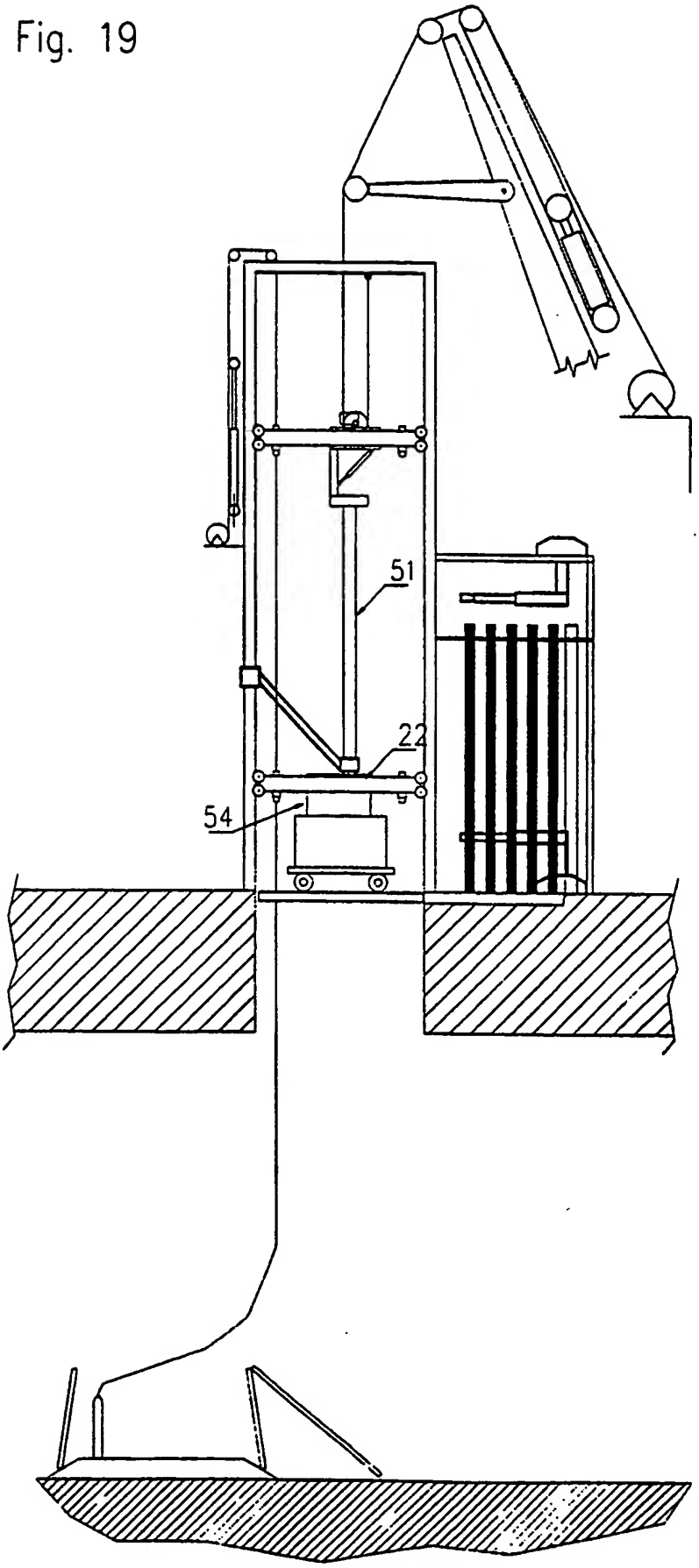

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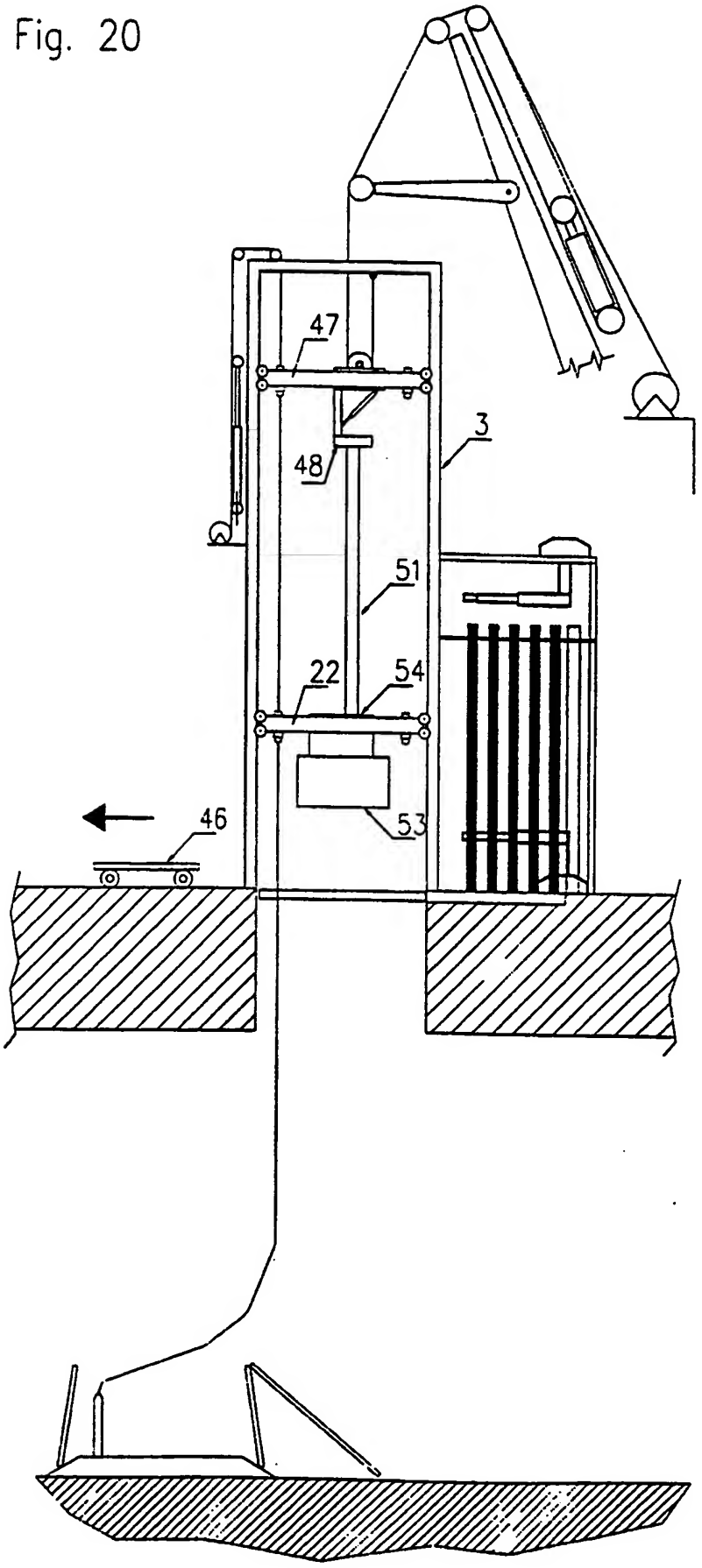

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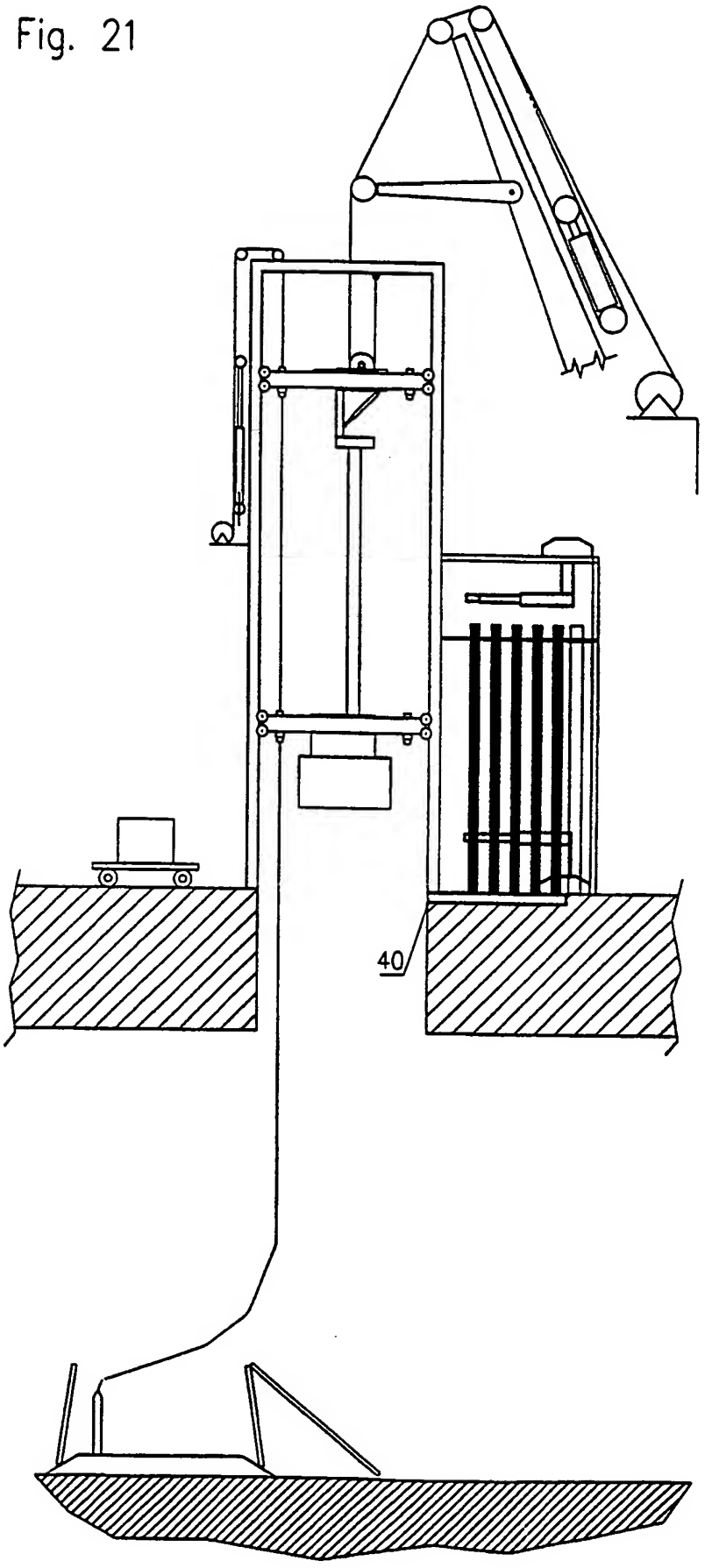

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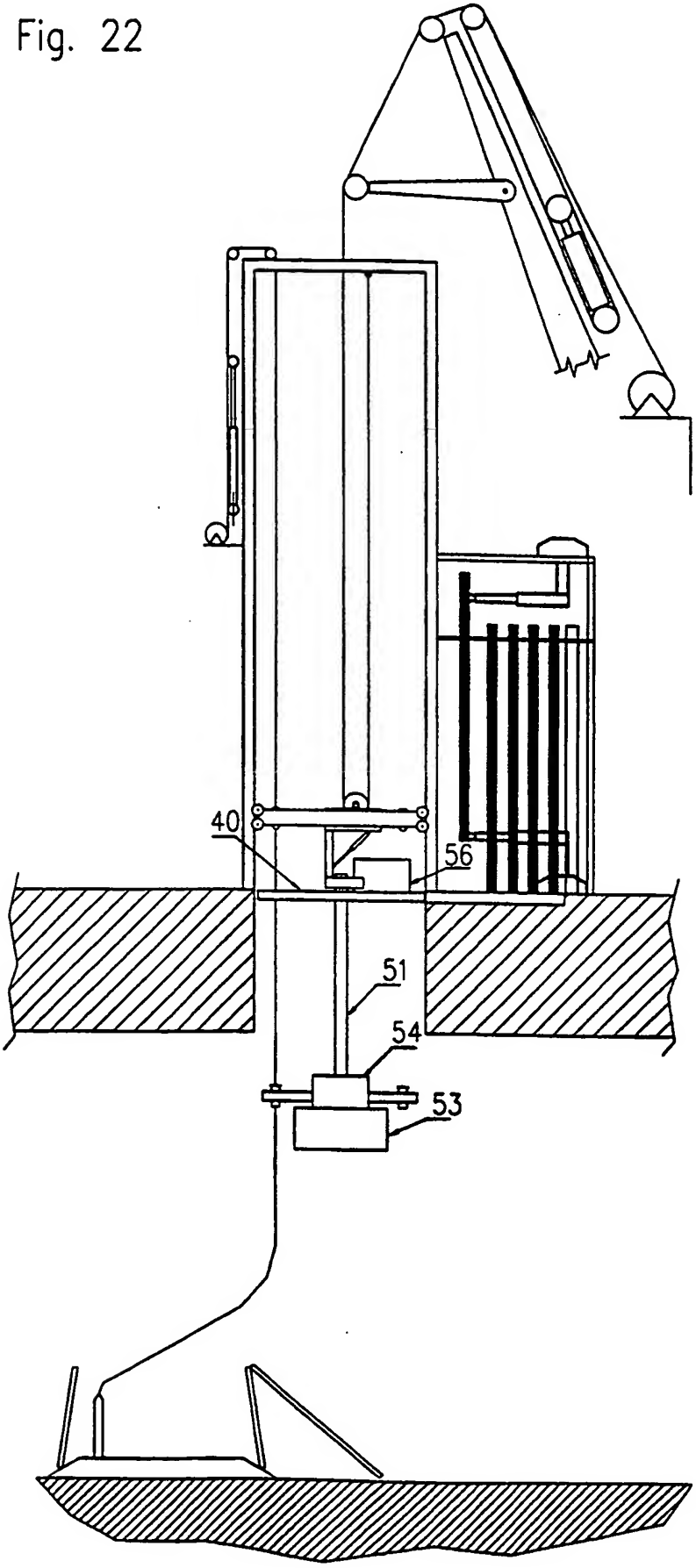

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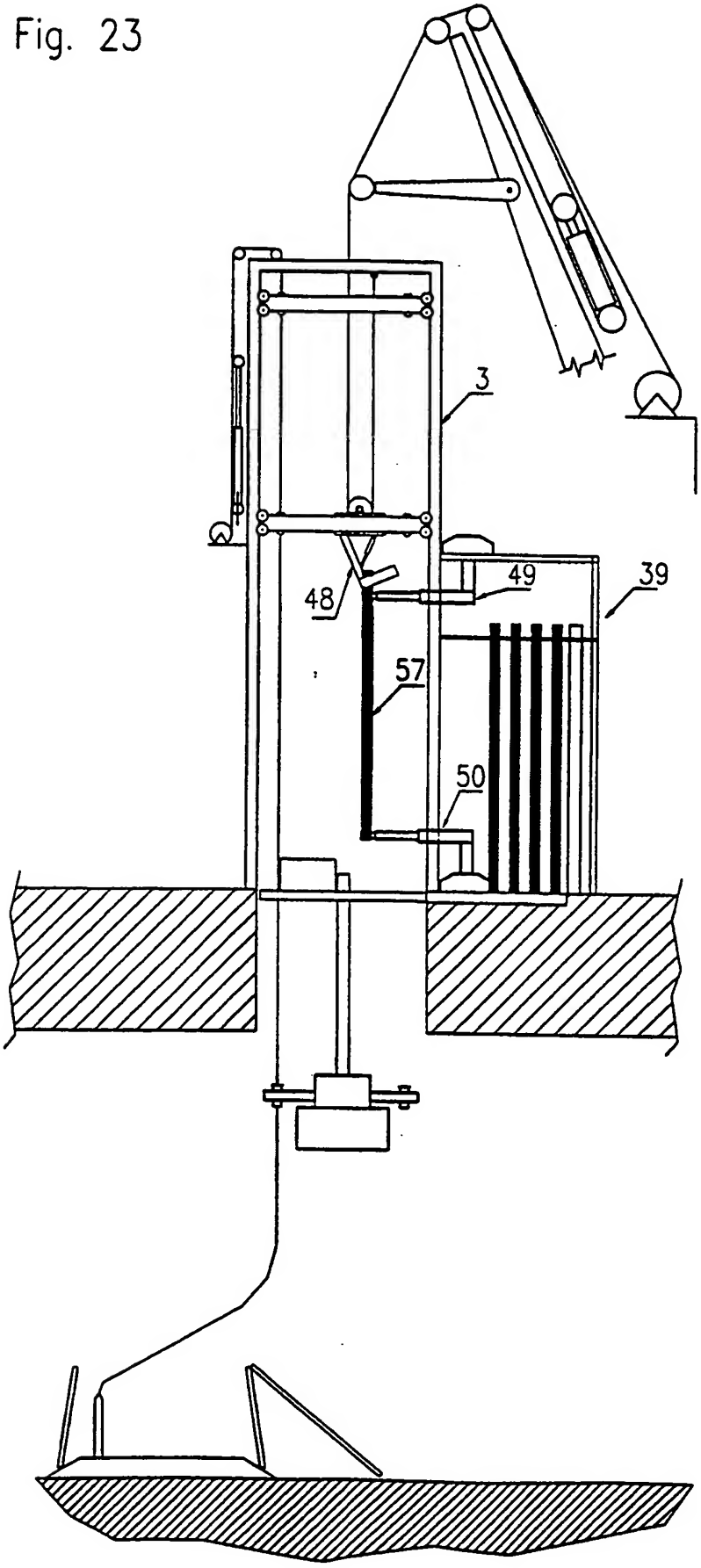

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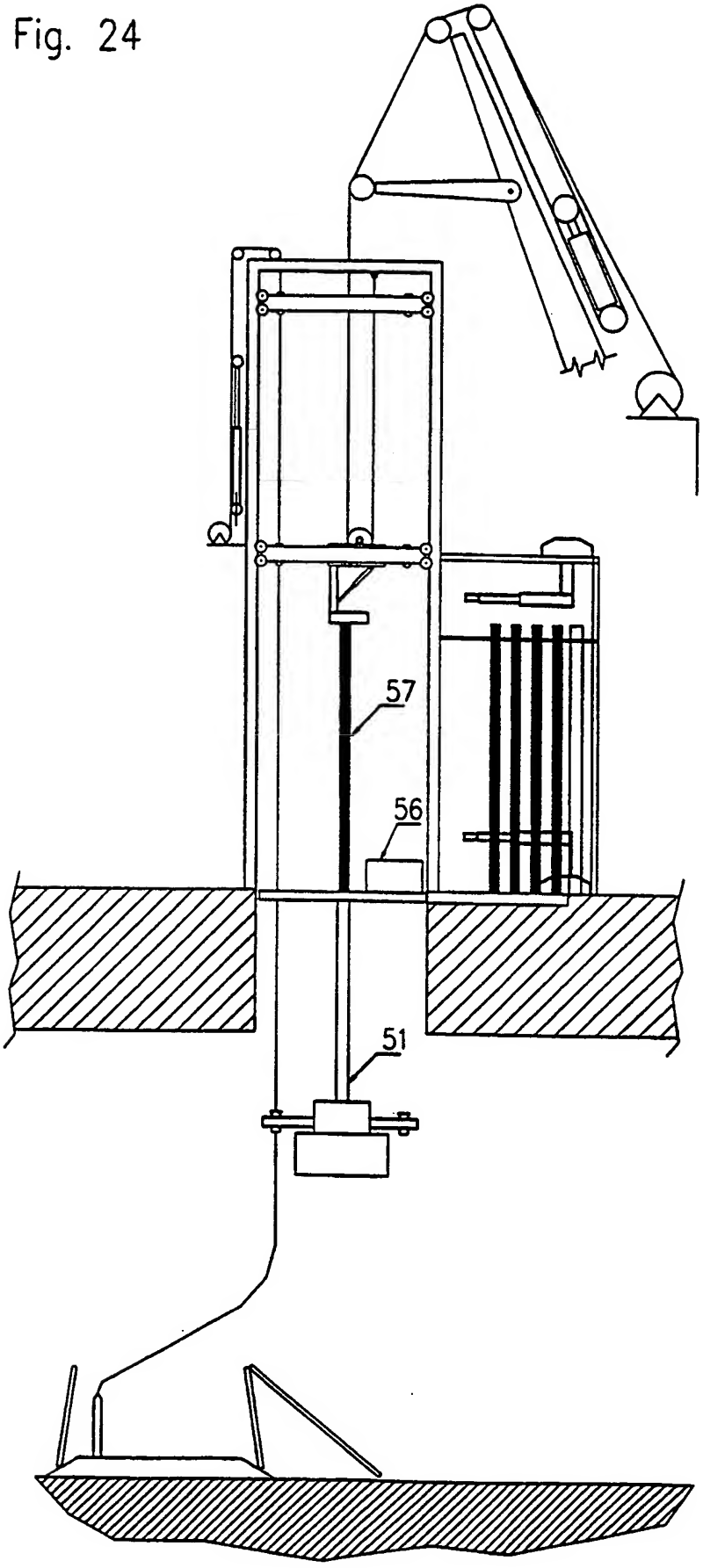

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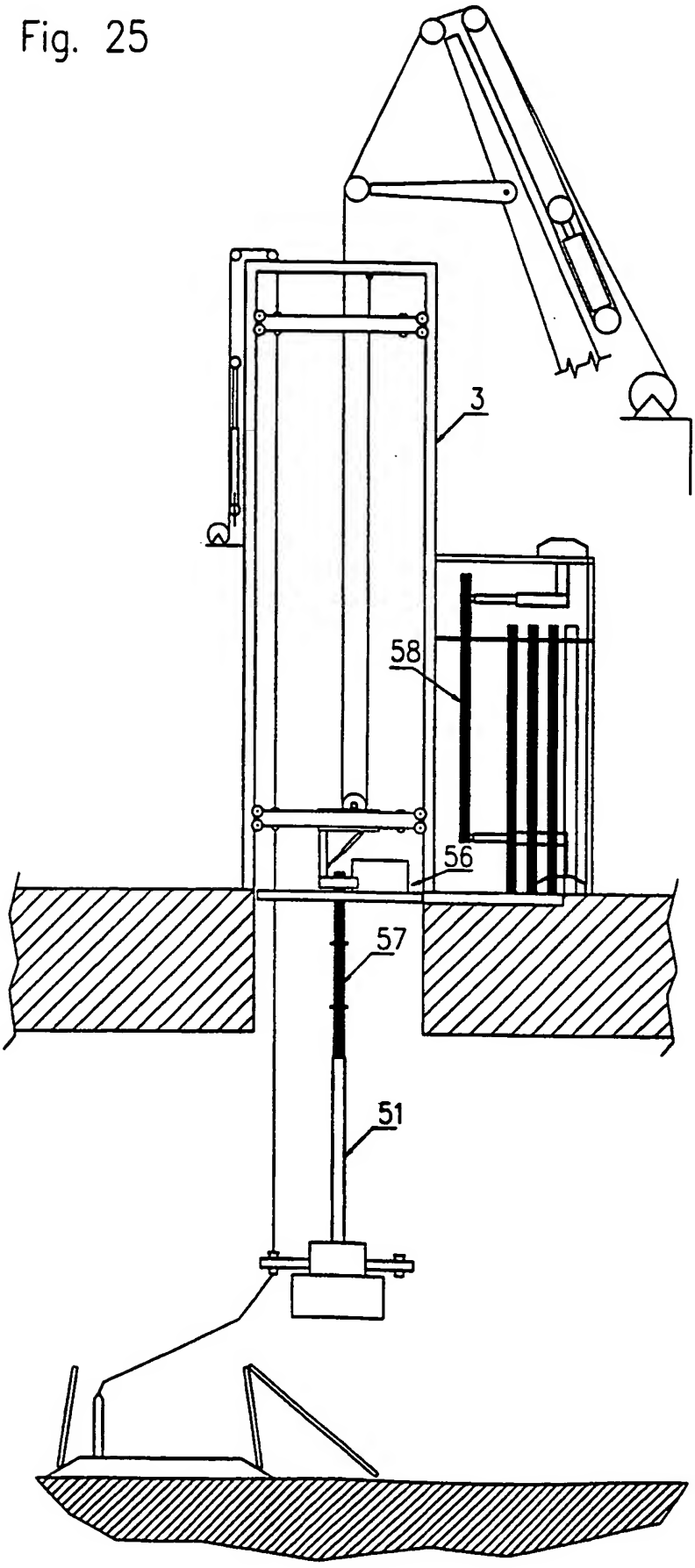

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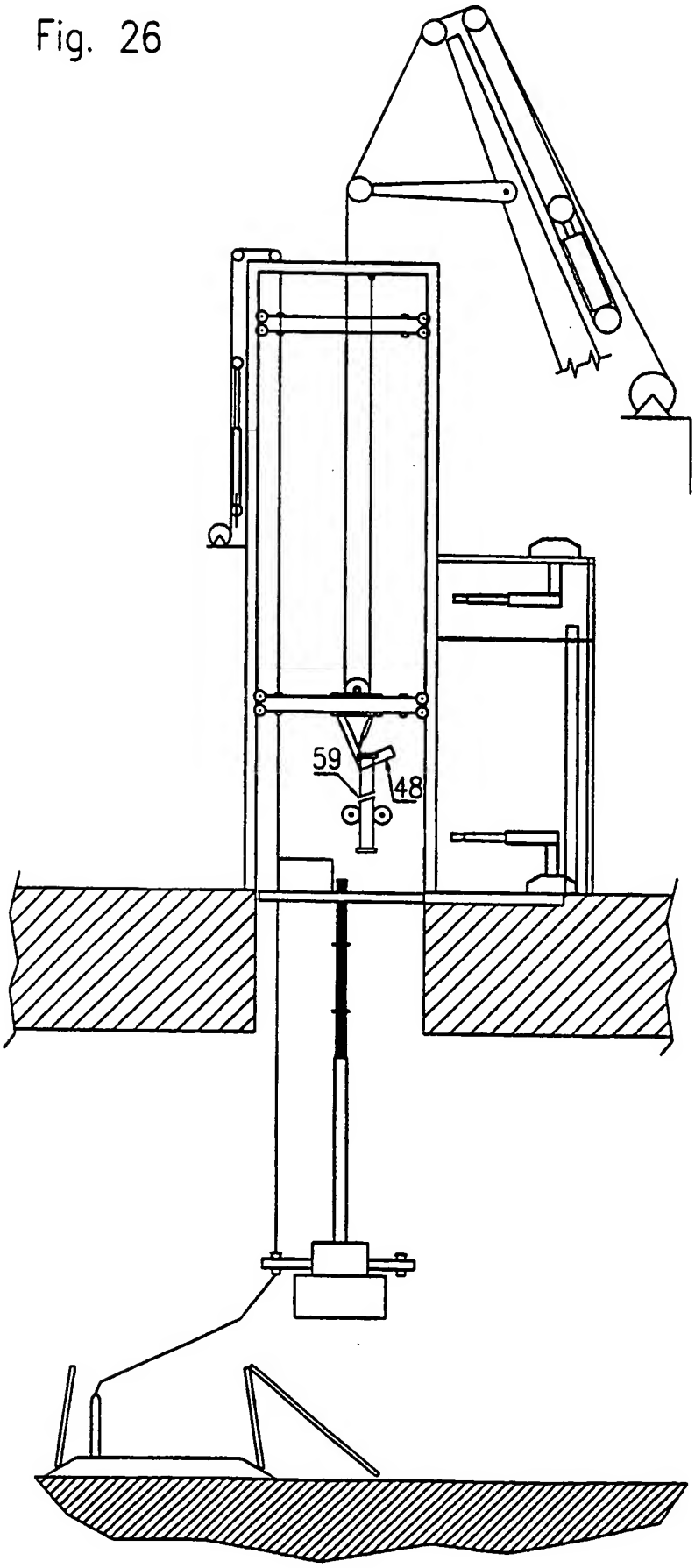

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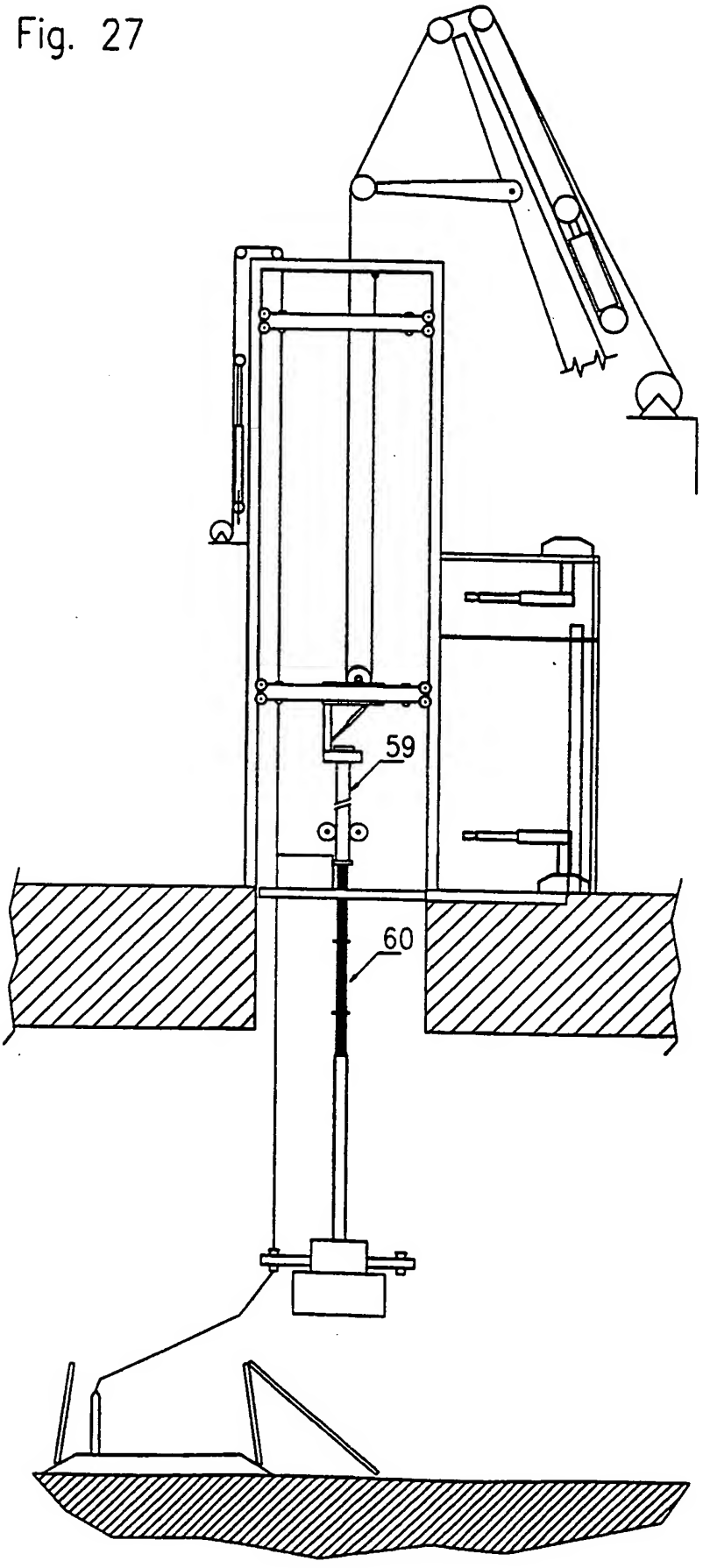

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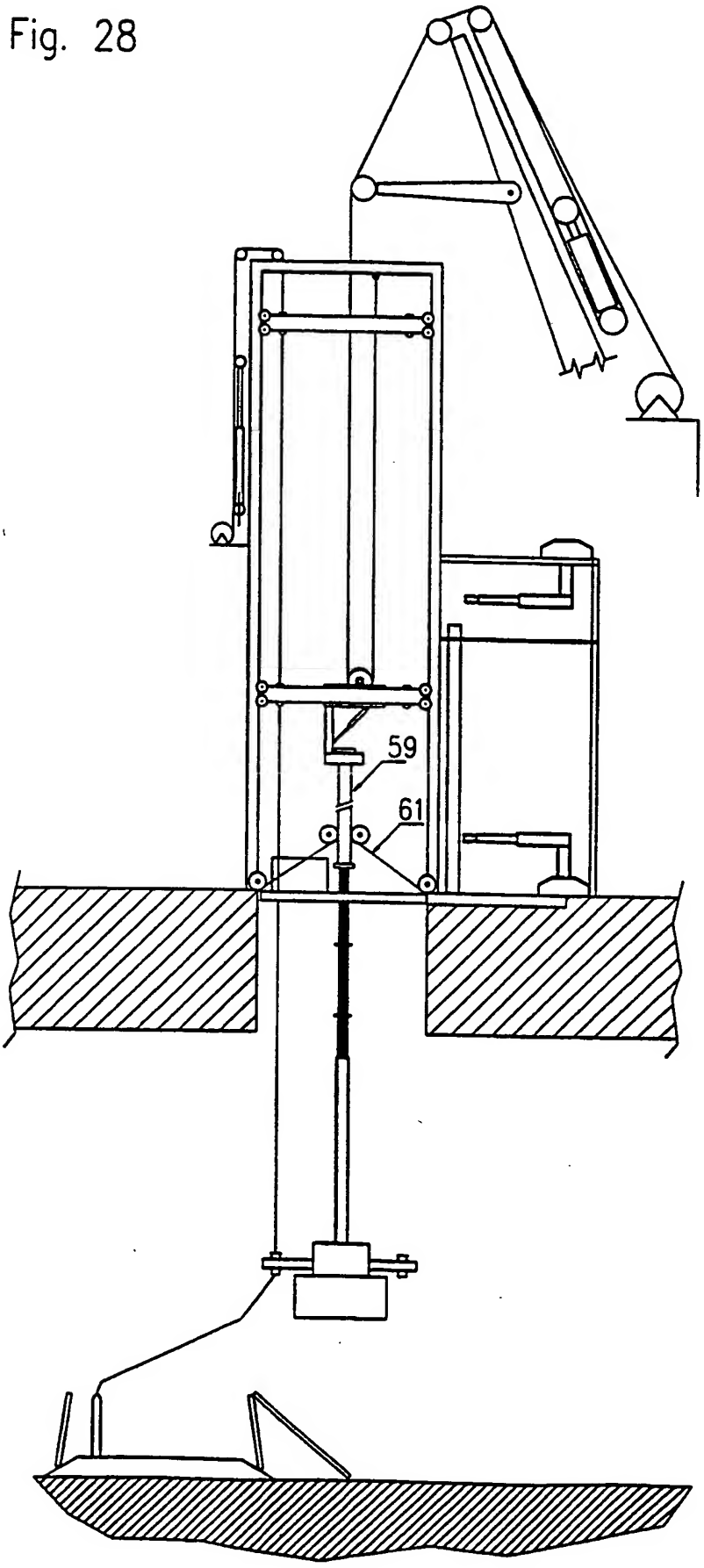

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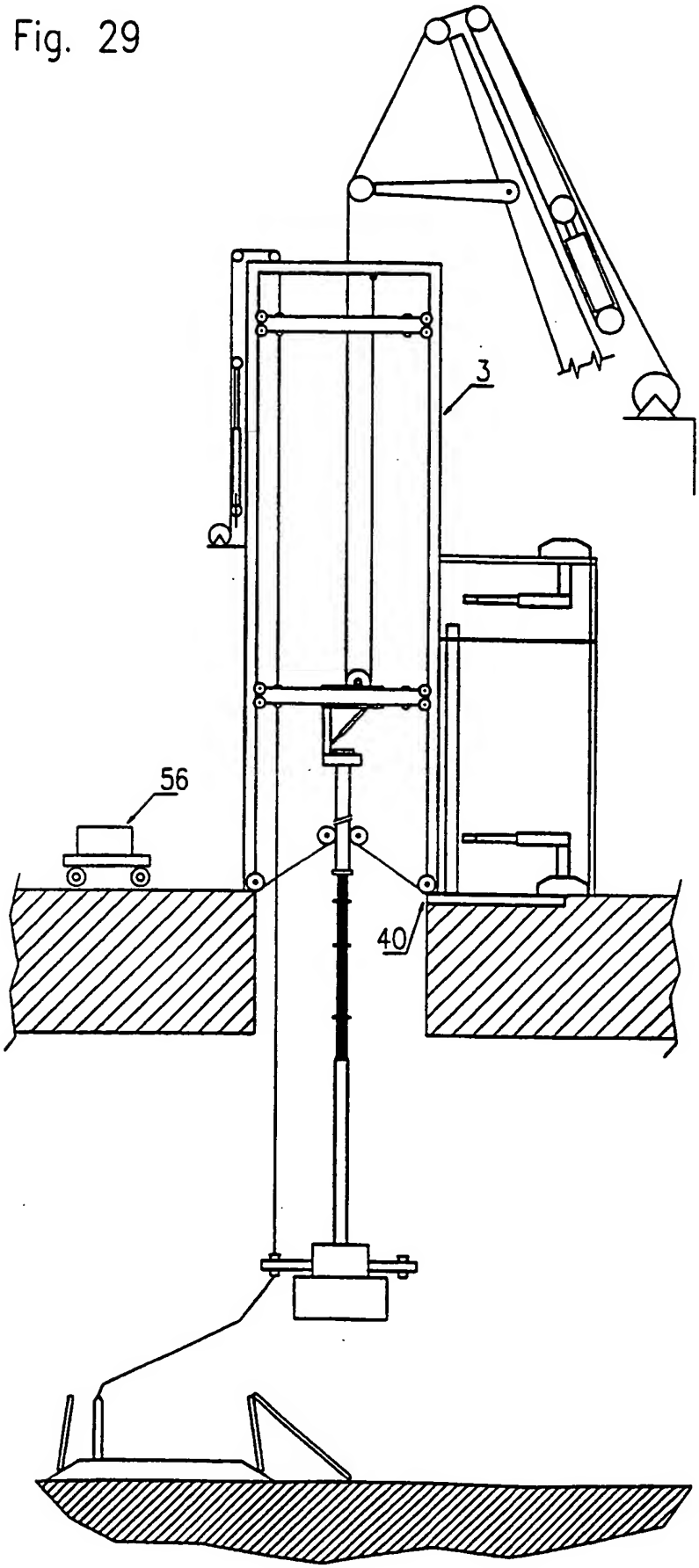

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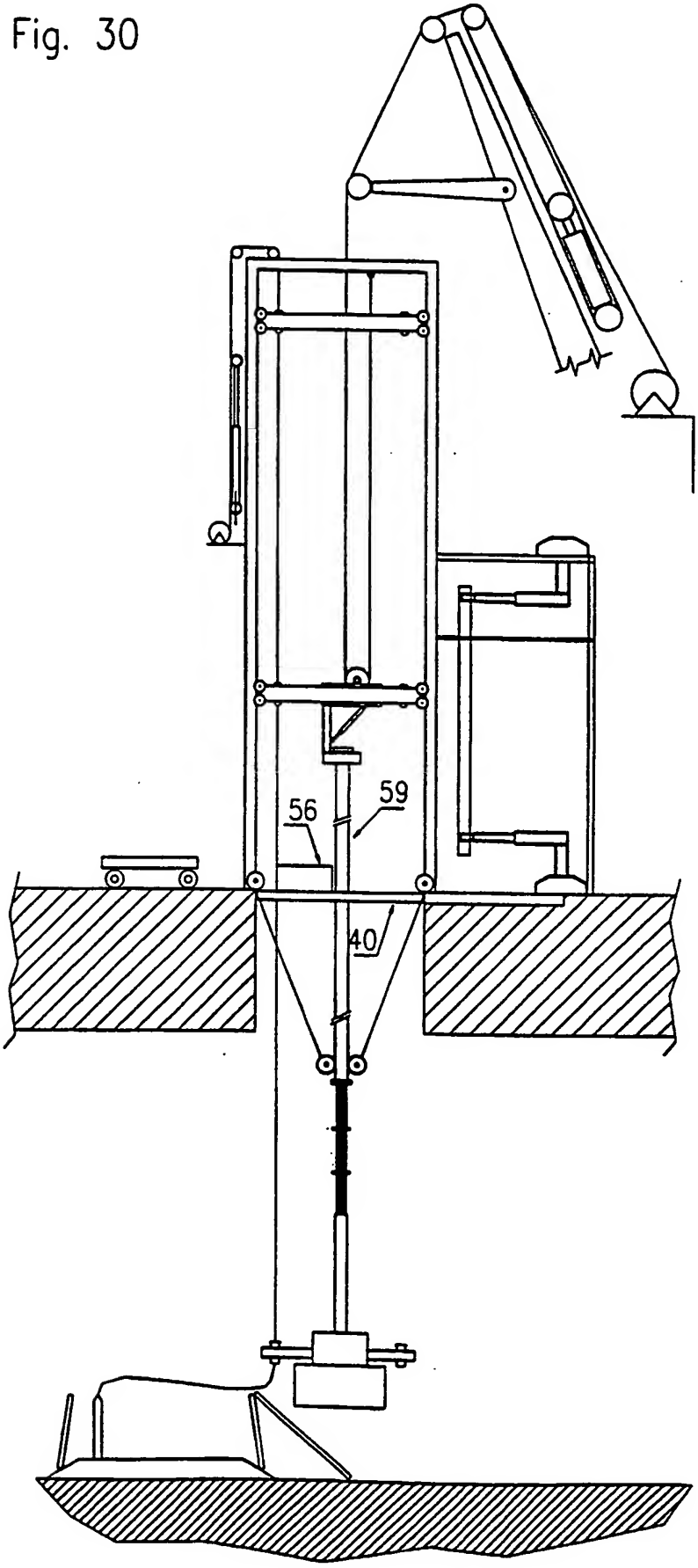

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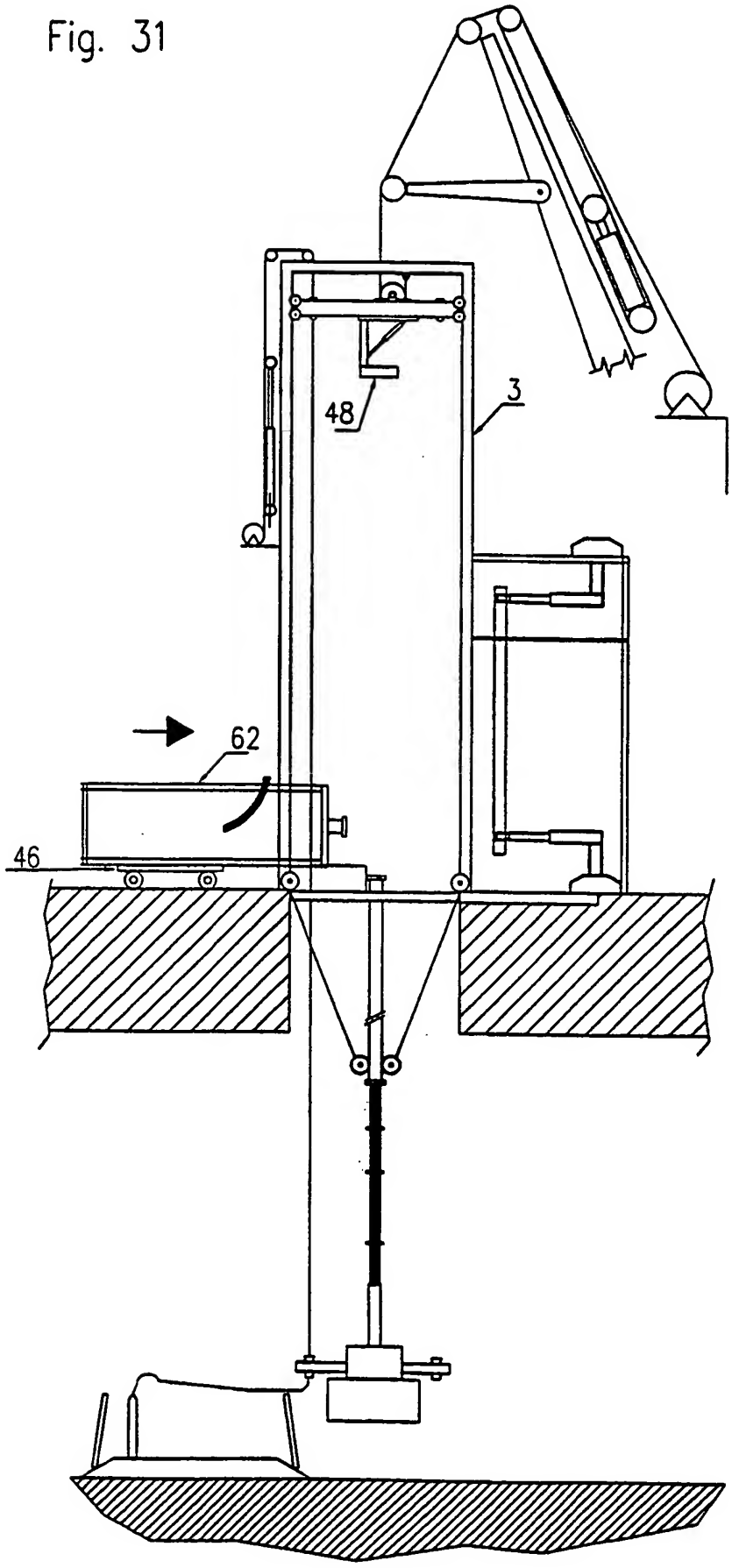

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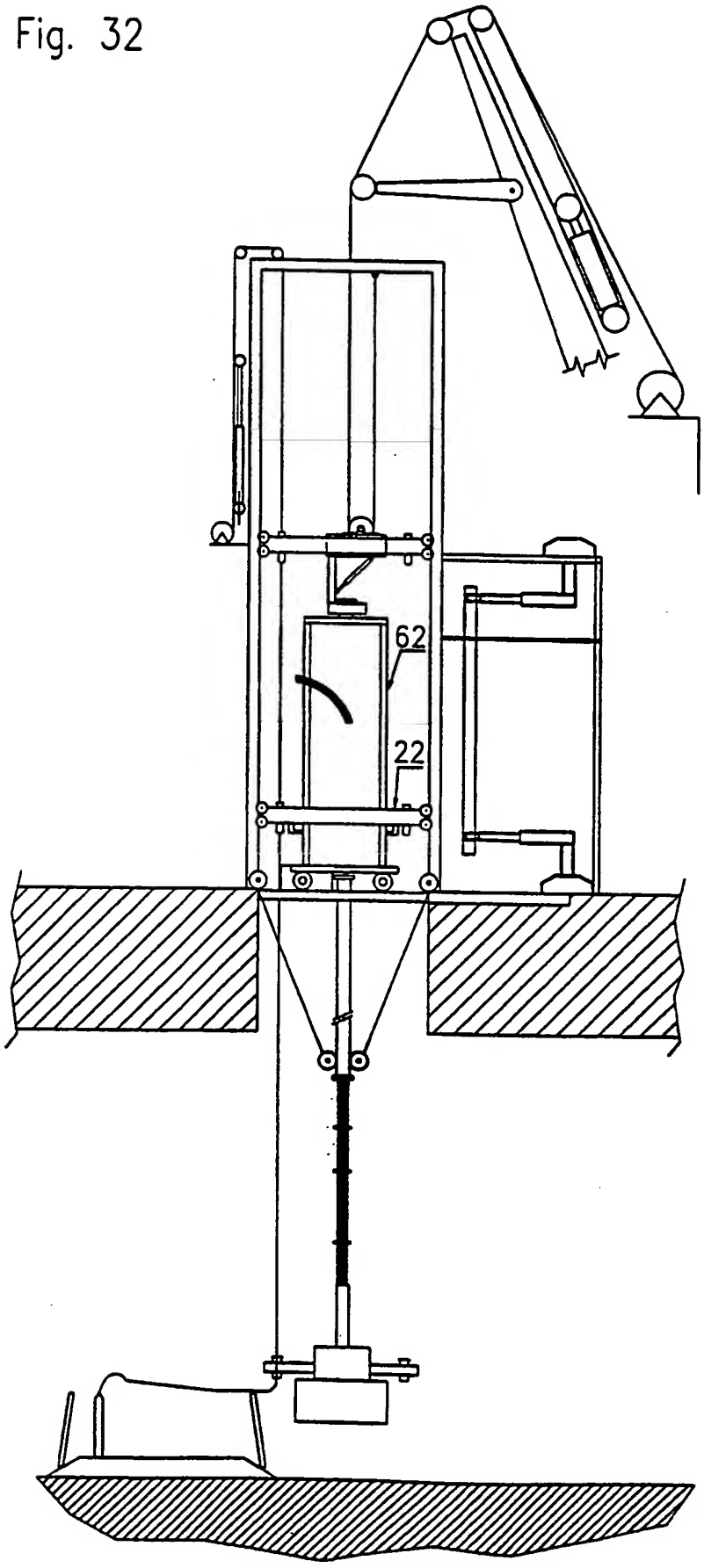

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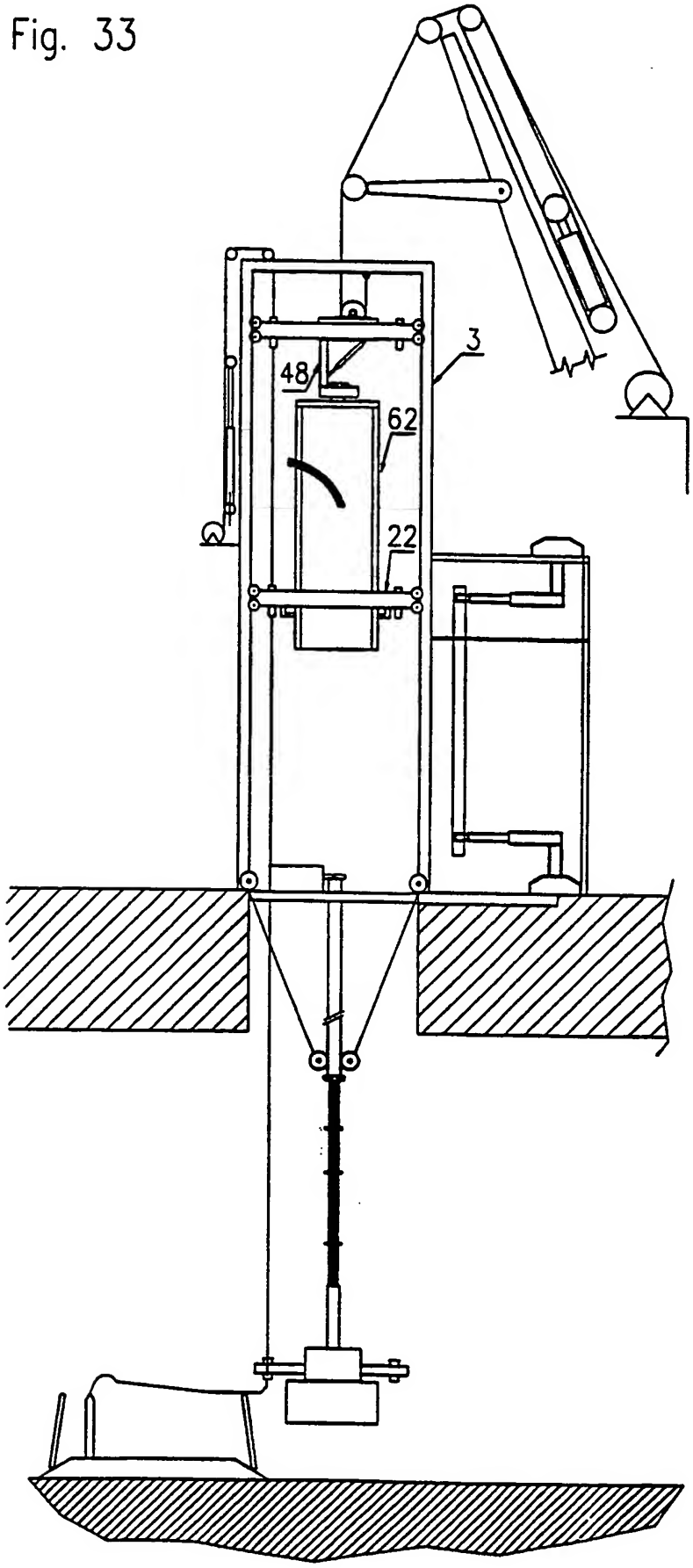

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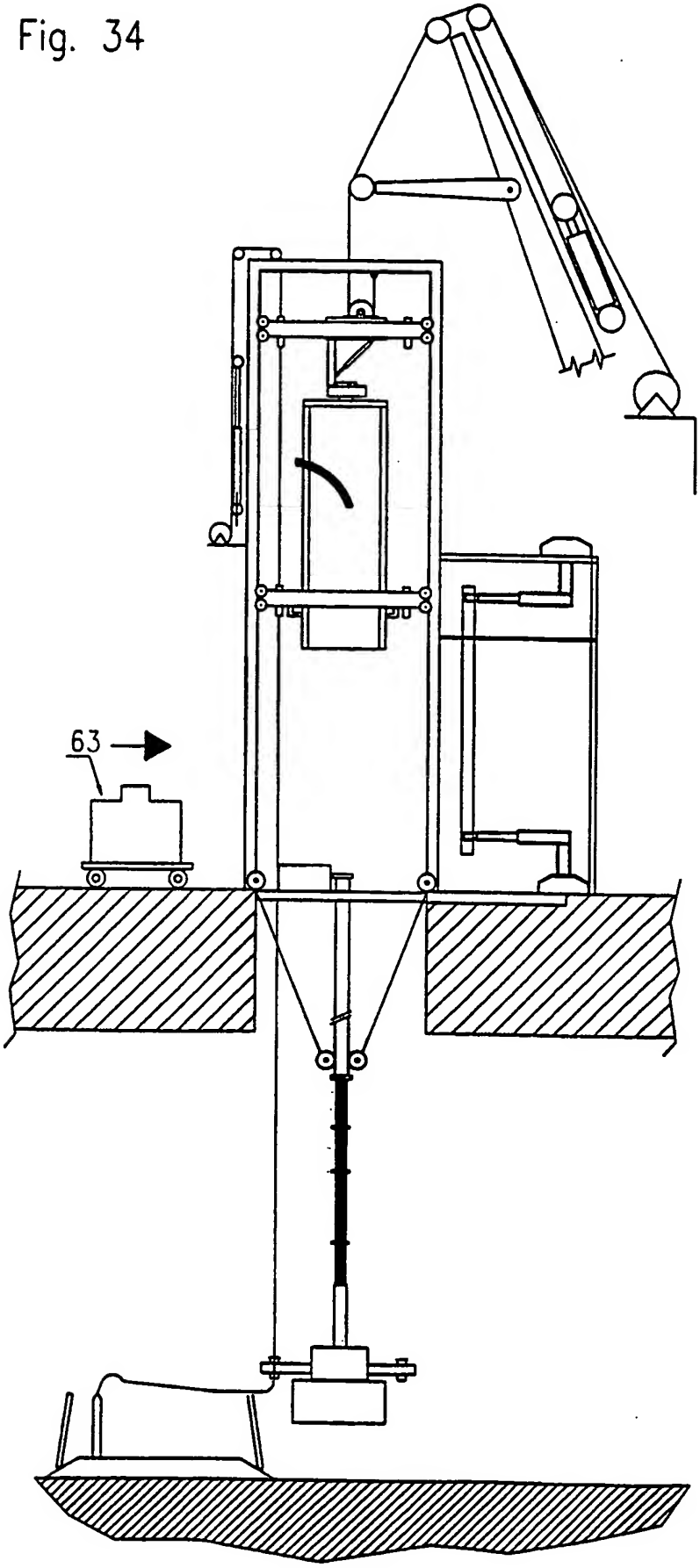

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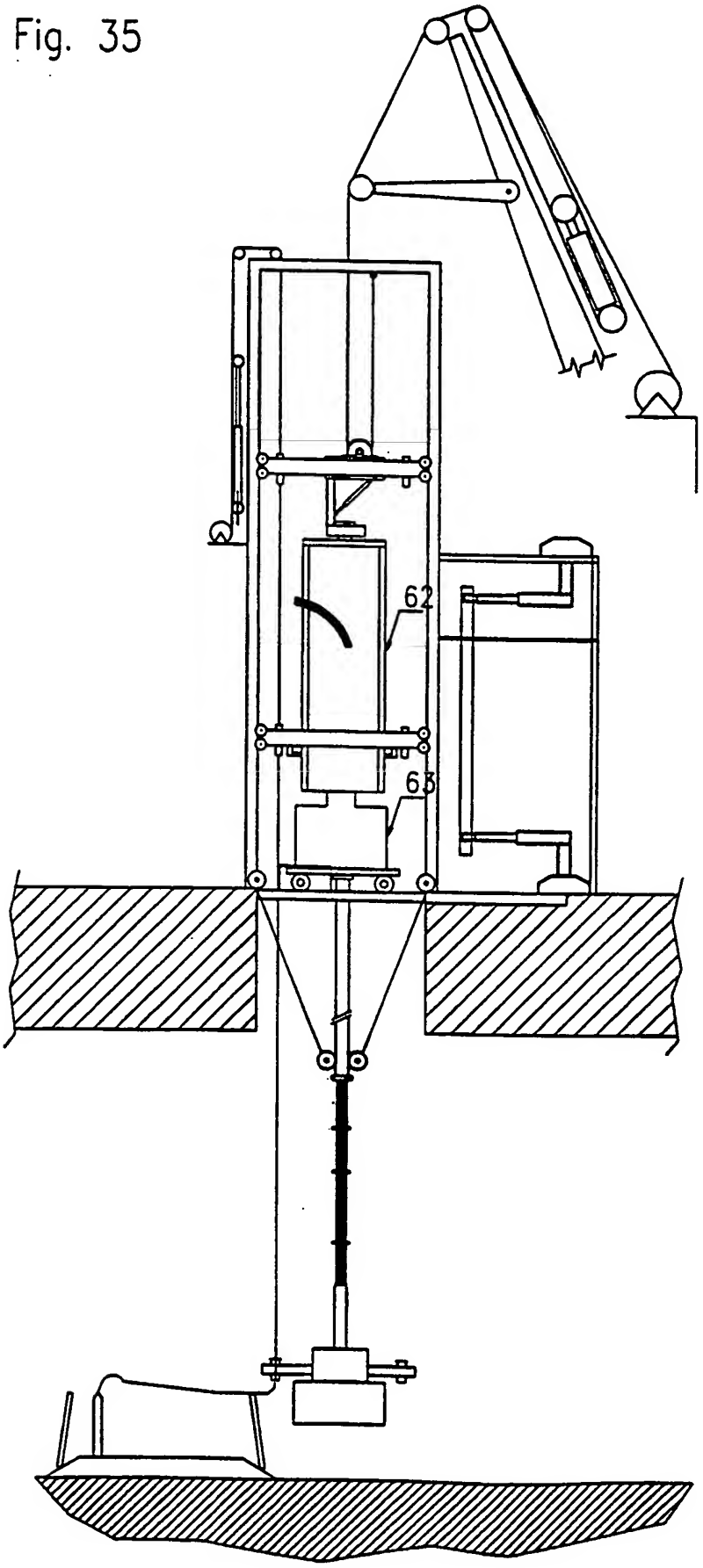

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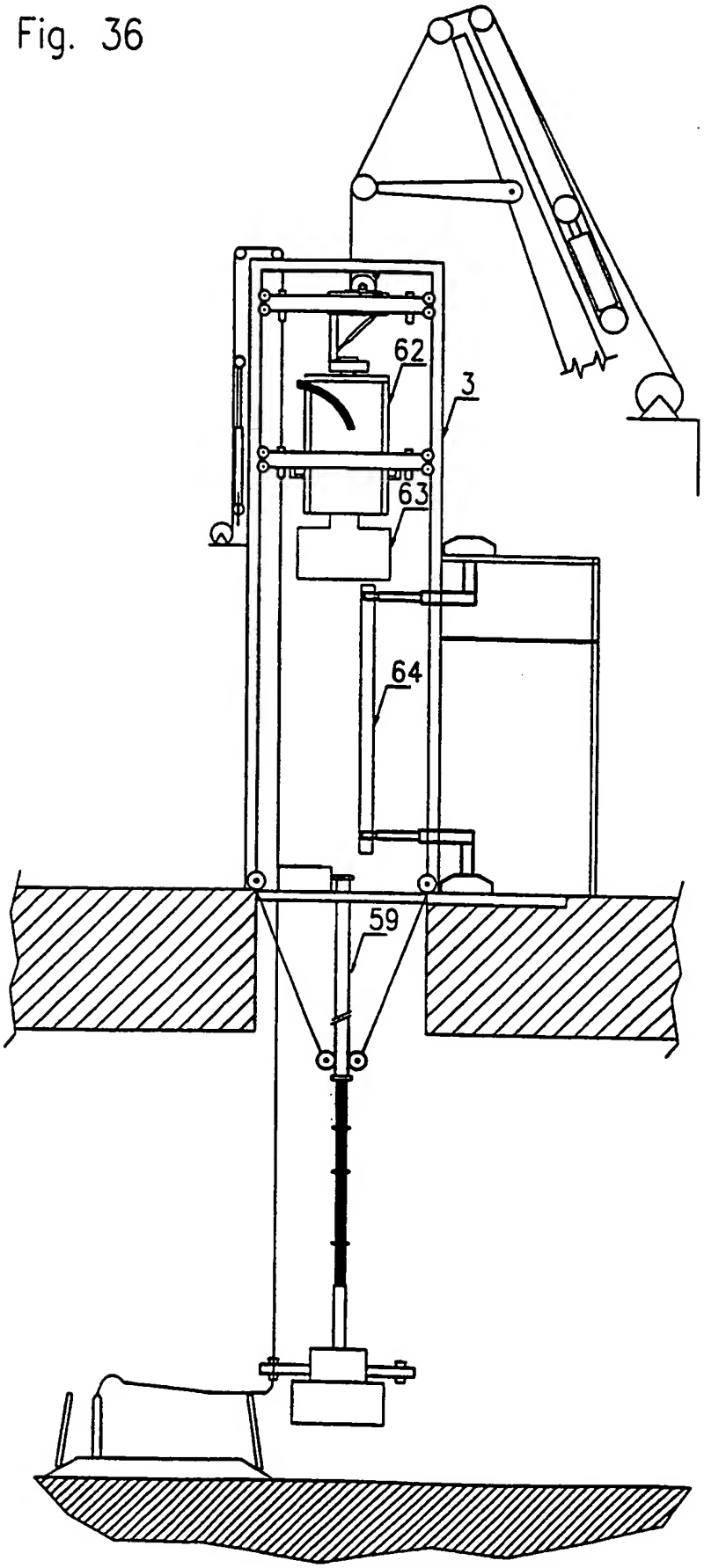

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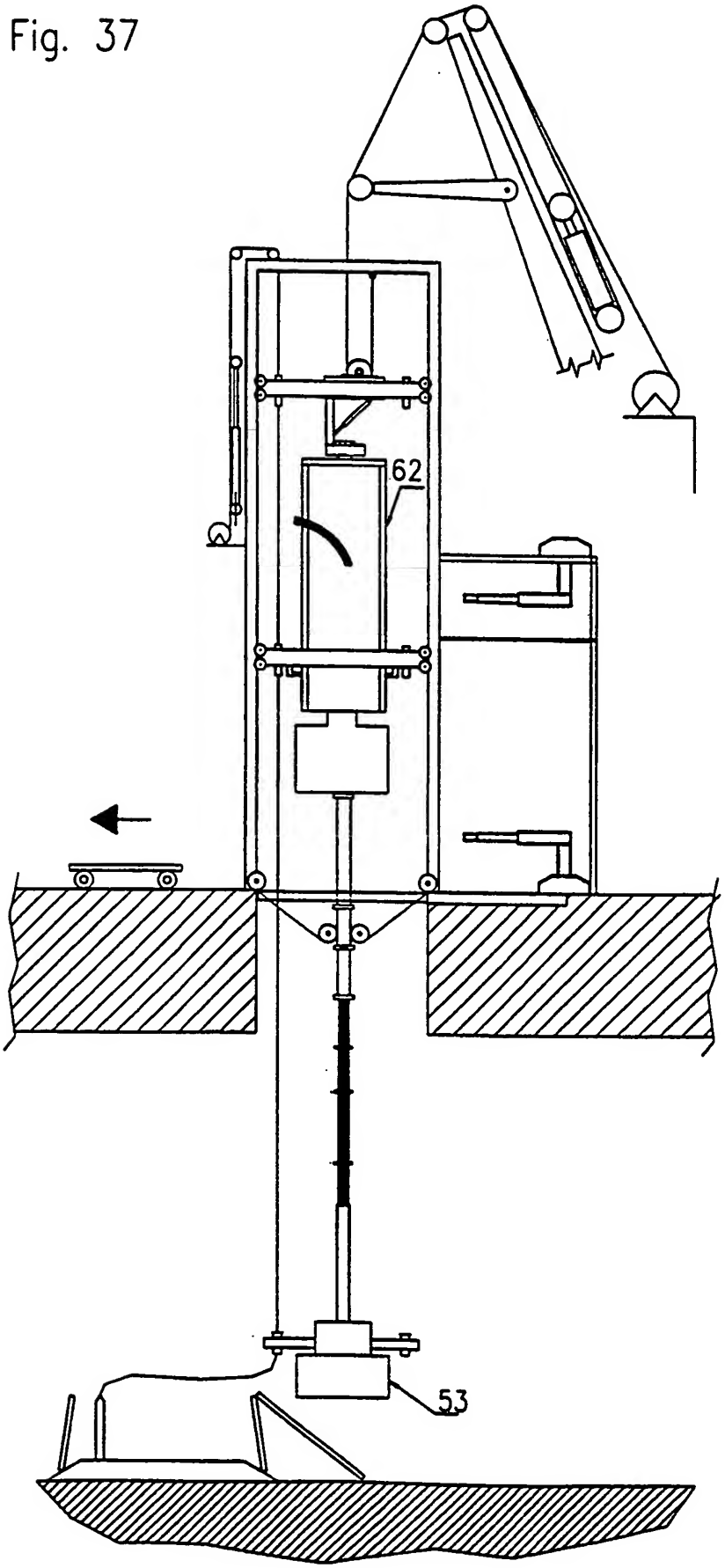

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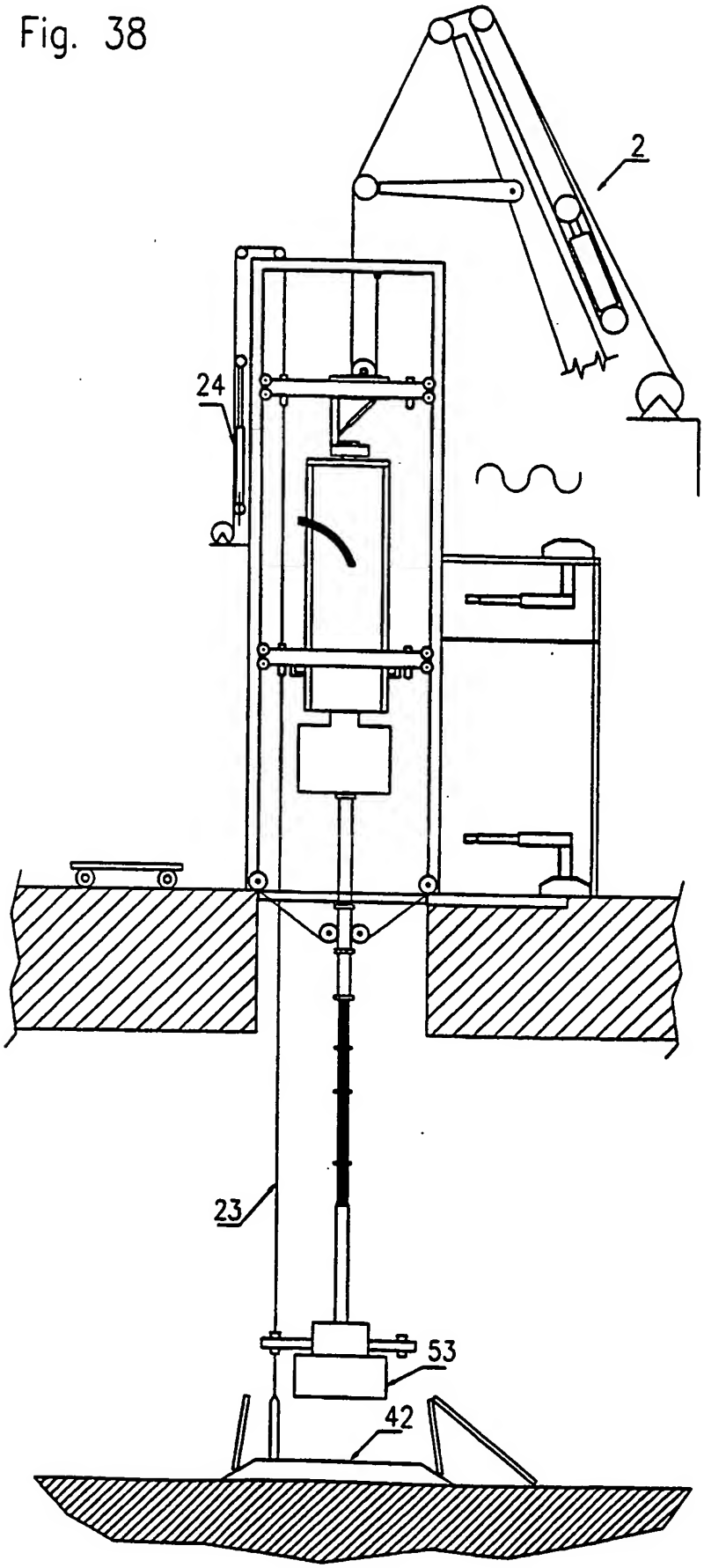

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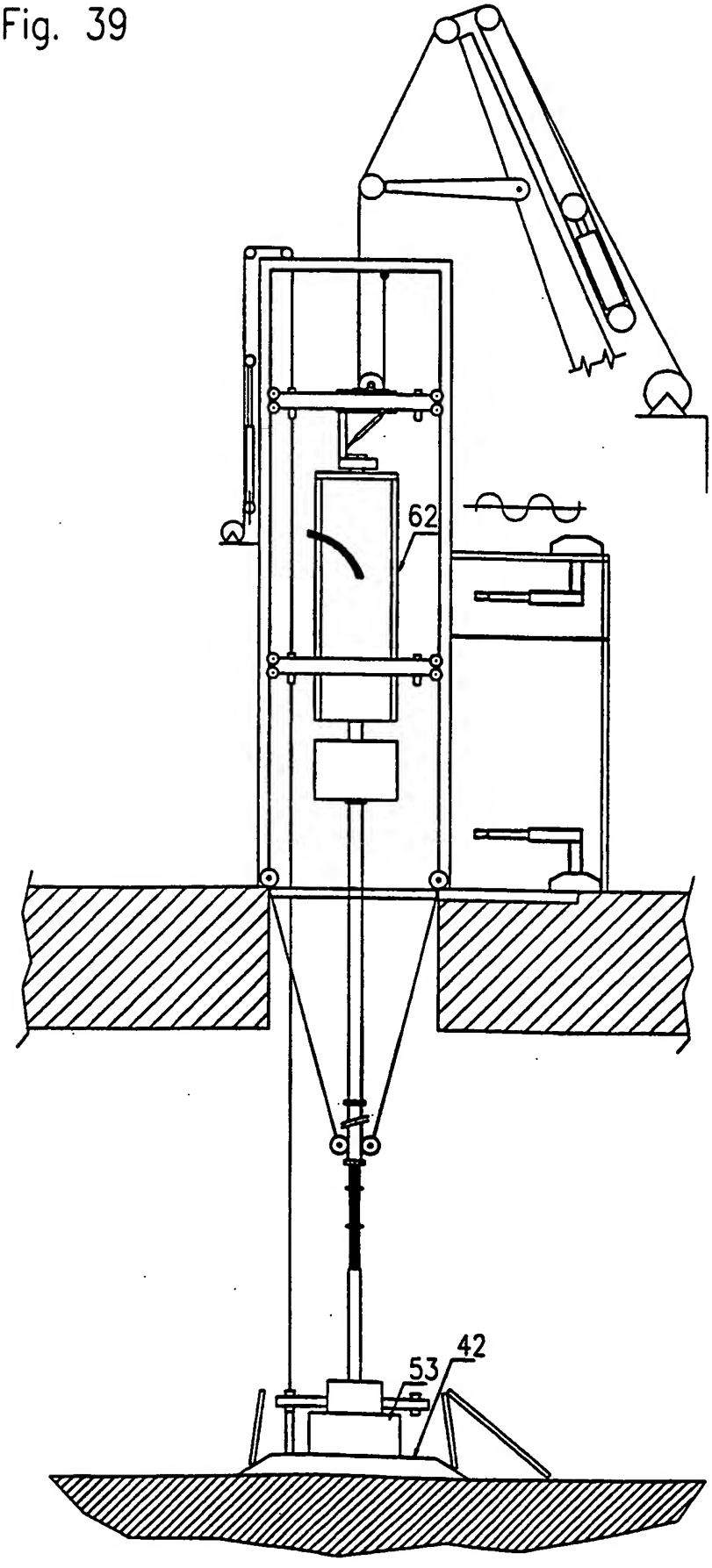

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 98/00250

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B63B 35/44
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B63B, E02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EDOC, WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4471708 A (WILSON ET AL), 18 Sept 1984 (18.09.84), column 9, line 1 - line 13, figures 1-3	1-8
A	GB 2026573 A (PETROLEO BRASILEIRO S.A.), 6 February 1980 (06.02.80), figures 1,2	1-8
A	WO 8505339 A1 (WORLEY ENGINEERING LIMITED), 5 December 1985 (05.12.85), figure 4	1-8
A	DE 2421150 B2 (ERNO RAUMFAHRTTECHNIK GMBH), 24 May 1978 (24.05.78), column 3, line 48 - line 54, figure 1	1-8

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
3 December 1998	04 -12- 1998
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Christer Jönsson Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/NO 98/00250

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4471708 A	18/09/84	AU 508699 A,B	27/03/80
		BR 7806652 A	03/07/79
		DE 2802239 A	03/05/79
		DK 440678 A	01/05/79
		FI 782868 A	01/05/79
		FR 2407122 A,B	25/05/79
		GB 1598216 A	16/09/81
		IE 47743 B	13/06/84
		NL 7810147 A	02/05/79
		SE 7809319 A	01/05/79
		US 4281615 A	04/08/81
GB 2026573 A	06/02/80	AR 225138 A	26/02/82
		BE 874521 A	18/06/79
		BR 7804645 A	22/01/80
		CA 1109279 A	22/09/81
		DE 2855752 A,C	07/02/80
		DK 151543 B,C	14/12/87
		DK 469078 A	20/01/80
		FI 77909 B,C	31/01/89
		FI 783432 A	20/01/80
		FR 2456167 A,B	05/12/80
		IE 47768 B	13/06/84
		JP 1099680 C	18/06/82
		JP 55019392 A	12/02/80
		JP 56041767 B	30/09/81
		NL 180947 B,C	16/12/86
		NL 7812049 A	22/01/80
		SE 437855 B,C	18/03/85
		SE 7812864 A	20/01/80
		US 4269542 A	26/05/81
WO 8505339 A1	05/12/85	BR 8506744 A	23/09/86
		FI 851960 A	18/11/85
		GB 2159114 A	27/11/85
		SE 8502446 A	18/11/85
DE 2421150 B2	24/05/78	GB 1505128 A	22/03/78
		US 3949693 A	13/04/76